

CORNWALL AIR QUALITY

1980 - 1984

MARCH, 1987

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Ministry
of the
Environment

David Guscott, Director
Southeastern Region

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TABLE OF CONTENTS

	<u>Page</u>
Summary	1
1.0 Introduction	2
2.0 Air Quality Instrumentation	4
2.1 Fixed and Continuous Monitoring	4
Total Reduced Sulphur (TRS)	4
Sulphur Dioxide (SO ₂)	6
Oxides of Nitrogen (NO _x)	7
Ozone (O ₃)	7
Carbon Monoxide (CO)	7
2.2 Fixed and Discrete Monitoring	8
Suspended Particulate	8
Soiling Index	8
2.3 Short Term Discrete Sample Surveys	9
Airborne Mercury	9
Airborne Fluorides	10
Dustfall	11
2.4 Mobile Monitoring	11
3.0 Pollutants, Processes and Local Sources	11
3.1 Total Reduced Sulphur	11
3.2 Sulphur Dioxide	13
3.3 Oxides of Nitrogen	14
3.4 Ozone	14
3.5 Carbon Monoxide	15
3.6 Fluorides	15
3.7 Mercury	16
3.8 Chlorine and Chlorine Dioxide	17
4.0 Data Analysis	17
4.1 Statistical Overview	17
4.1.1 Parametric/Non Parametric Test Methods	17
4.1.2 Homogeneity/Stratification	21
4.2 Methodology	22

TABLE OF CONTENTS

	<u>Page</u>
4.3 Evaluation of Continuously Monitored Pollutants	23
4.3.1 TRS	23
4.3.2 SO ₂	26
4.3.3 CO	27
4.3.4 Oxides of Nitrogen	27
4.3.5 Ozone	27
4.3.6 Soiling Index	28
4.4 Source Apportionment	29
4.5 Evaluation of TSP Data	34
4.6 Fluorides	34
5.0 Air Quality Index	35
6.0 Conclusions - Future Monitoring Considerations	37

APPENDICES

Page

Appendix A1 - Multi-year Summaries

TRS - Memorial Park	A1.1
TRS - St. Francis School	A1.2
Sulphur Dioxide (SO ₂)	A1.3
Carbon Monoxide (CO)	A1.4
Nitric Oxide (NO)	A1.5
Nitrogen Dioxide (NO ₂)	A1.6
Total Oxides of Nitrogen (NO _x)	A1.7
Ozone (O ₃)	A1.8
Soiling Index (COH)	A1.9

Appendix A2 - Source Related Crosstabulations of TRS Data - 4 km/hour cutoff	A2.0
---	------

Appendix A2.2 - Sample Normal Distributions	A2.1
---	------

Figures F1 - Summary Statistics Plots

TRS - Memorial Park	F1.1
TRS - St. Francis School	F1.2
Sulphur Dioxide (SO ₂)	F1.3
Carbon Monoxide (CO)	F1.4
Nitric Oxide (NO)	F1.5
Nitrogen Dioxide (NO ₂)	F1.6
Total Oxides of Nitrogen (NO _x)	F1.7
Ozone (O ₃)	F1.8
Soiling Index (COH)	F1.9

Figures F2 - Three Dimensional Plots

TRS - Memorial Park	F2.1
TRS - St. Francis School	F2.2
Sulphur Dioxide (SO ₂)	F2.3
Carbon Monoxide (CO)	F2.4
Nitric Oxide (NO)	F2.5
Nitrogen Dioxide (NO ₂)	F2.6
Total Oxides of Nitrogen (NO _x)	F2.7
Ozone (O ₃)	F2.8

Figures F3 - Source Related Three Dimensional Plots

Memorial Park	
Domtar	F3.1
Courtaulds	F3.2
Unknown	F3.3
Other	F3.4
St. Francis School	
Domtar	F3.5
Courtaulds	F3.6
Unknown	F3.7
Other	F3.8

APPENDICES

	<u>Page</u>
Figures F4 - Frequency Plots	
TRS - Memorial Park	F4.1
Sulphur Dioxide (SO ₂)	F4.2
Carbon Monoxide (CO)	F4.3
Nitric Oxide (NO)	F4.4
Nitrogen Dioxide (NO ₂)	F4.5
Total Oxides of Nitrogen (NO _x)	F4.6
Ozone (O ₃)	F4.7
Soiling Index (COH)	F4.8
Appendix A5 - Fluoride Data	A5
Appendix A6 - Source Related Crosstabulations of TRS data - 2 km/hour cutoff	A6
Appendix A7 - Total Suspended Particulate Data	A7
Appendix T1 - Glossary of Statistical Terms	T1.1
Appendix M1 - Maps	M1
Bibliography	B1

SUMMARY

To assess air quality in the Cornwall area, the Ontario Ministry of the Environment monitors for a variety of pollutants on a continuous or intermittent basis. This monitoring is supplemented by project specific surveys including phytotoxicology, mobile air monitoring units (MAMU) and source emission studies. Environment Canada also conducts air monitoring in the Cornwall area. Survey and monitoring information is routinely released in various reports and tables. The purpose of this report is to provide an overview interpretation of air quality in the Cornwall area for the period 1980 to 1984.

The Ontario criteria for desirable air quality were met for carbon monoxide, oxides of nitrogen and total suspended particulates. Sulphur dioxide was occasionally elevated over the one hour criterion, as was Soiling Index. These occurrences were infrequent and show no trend. Ozone concentrations occasionally exceeded the air quality criterion (approximately 100 hours per year). These occurrences are episodic and occur during the summer months. 1983 experienced the most frequent ozone exceedances and the years 1980, 1981, 1982 and 1984 were very similar to each other. No vegetation damage has been observed which was attributable to ozone.

Ground level concentrations of reduced sulphurs (hydrogen sulphide, ethyl mercaptan, methyl mercaptan), a particularly odourous class of chemicals frequently exceed the kraft mill provisional guideline of 27 parts per billion hydrogen sulphide.

Each of the major industrial sources of reduced sulphurs in Cornwall have had a continued detrimental impact on the Cornwall airshed. Probability models can attribute many hours of undesirable air quality to both Domtar Fine Papers (Domtar) and Courtaulds Canada (Courtaulds). This occurred despite Domtar's compliance with its control order.

Courtaulds pollution control equipment has operated very irregularly over the period of this report. The incinerator was out of service from February 1983 until June 1984. Improved abatement and monitoring strategy has been devised and will be implemented in 1987.

The MOE does not have ambient air data for chlorine and chlorine dioxide. Phytotoxicology studies have documented limited damage to vegetation in the immediate vicinity of Domtar. These episodes may have been caused by short term process upsets or equipment failure. An ambient chlorine monitor has been ordered by the Ministry for installation close to Domtar.

Short term surveys have detected mercury, but at levels below the Ontario criterion for air quality. Mercury has been found in vegetable plots and soil in the vicinity of C-I-L Inc. (CIL). CIL emissions of mercury are within Federal guidelines. The routes and pathways of mercury emissions and uptake by plants are under investigation by the Phytotoxicology Section of the Air Resources Branch.

The Ministry is installing an Air Quality Index system in Cornwall as part of a Province-wide network. The purpose of the system is to keep the public regularly informed of the ambient air quality. Applying the Index design for AQI to the data in this report shows hundreds of hours of poor air quality in Cornwall, primarily due to reduced sulphurs. The basis for the AQI system is a real time telemetry network which will allow meteorological parameters to be available as an aid to evaluating the pollutant concentrations.

1.0 INTRODUCTION

The Ontario Ministry of the Environment has operated air monitoring stations in Cornwall since 1971.

The current Cornwall configuration includes monitors for hydrogen sulphide (H_2S), sulphur dioxide (SO_2), Ozone, oxides of nitrogen (NO_x), carbon monoxide (CO) soiling index, and suspended particulate matter. The monitor locations are depicted in Appendix M1.1.

The main Cornwall station, located in Memorial Park (56051), is also in the National Air Pollution Survey (NAPS) monitoring system. This system provides data to assess long-term trends in pollutant concentrations in major Canadian centres across the Canada. Data measured at station 56051 are reported annually by Environment Canada in a compilation of results from all NAPS stations.

The Air Resources Branch of the Ontario Ministry of the Environment publishes an annual report listing the pollutant concentrations observed at all continuous air monitoring stations in Ontario.

This report presents an interpretation of the air quality in the Cornwall area for the period 1980 to 1984 and highlights some of the factors which influence ambient air quality and its measurement. The report also makes reference to other studies completed in the Cornwall area including mobile air monitoring studies, phytotoxicology studies and other special surveys.

2.0 AIR QUALITY MONITORING INSTRUMENTATION

There are many broad classifications of air pollutants and an equally broad range of instrumentation and methods used in pollutant monitoring. A brief description of each type of pollutant and the measurement method used in Cornwall is provided.

There are four major classifications of monitoring equipment.

1. Fixed and continuous monitoring.
2. Fixed and discrete monitoring.
3. Mobile monitoring.
4. Short term discrete monitoring.

2.1 FIXED AND CONTINUOUS MONITORING

The fixed and continuous monitoring classification refers to permanently sited survey stations which are equipped to monitor pollutants in real time. In Cornwall, there are three stations where this format is utilized. Parameters monitored include:

1. Total reduced sulphur (TRS).
2. Sulphur dioxide (SO₂).
3. Carbon monoxide (CO).
4. Oxides of nitrogen (NO_x).
5. Soiling index (COH).
6. Ozone (O₃).

Total Reduced Sulphur

The monitor used to measure total reduced sulphur in Cornwall was a Philips 9700 series H₂S analyser. This is a "wet chemical" analyser. The presence of hydrogen sulphide in

air, which is bubbled through a reactor cell, liberates bromine ions which are electronically sensed. This instrument will react to any compound which can liberate bromine ions. The most common interferences and their impact on the recorded concentration are detailed in Table I. "% interference" denotes the magnitude of the instrument output reading compared to the concentration of the interference in the gas sample, e.g. 1 ppm of SO₂ in the inlet gas produces an output concentration of 0.01 ppm. In essence, the only significant interference is methyl mercaptan, a reduced sulphur compound which is included in the TRS regulation for kraft mills.

Table 1

Total Reduced Sulphur Monitor Response to Interference

<u>Compound</u>	<u>% Interference</u>
NO ₂	LT 1%
O ₃	LT 1%
SO ₃	LT 1%
Methyl Mercaptan	100%
NO	LT 1%
Aldehydes	LT 1%
CS ₂	LT 1%

The instrument used to monitor total reduced sulphur is calibrated with hydrogen sulphide (H₂S). It is customary to report measured concentrations of TRS as H₂S since for most of the time, in many locations, H₂S is the only reduced sulphur compound present.

In the Cornwall area other reduced sulphur compounds have been detected. Ministry experience indicates that many of these compounds will not give a monitor response greater than an equivalent concentration of H₂S (e.g. ethyl mercaptan), and other compounds produce a response less than that of H₂S (e.g. dimethyl disulphide). Considering the significance of

these other compounds (concentration, frequency of occurrence) compared to H_2S , and hence the relative impact on the TRS component of air quality (which is primarily determined by H_2S), it is customary to use H_2S as a surrogate tracer for all reduced sulphur compounds.

Carbon disulphide (CS_2) is present in significant concentrations in ambient air (based on stack test data (2)) in the Cornwall area. This reduced sulphur compound is not monitored by this instrument. The guideline used to assess air quality with respect to TRS concentrations was developed for locations where CS_2 was not expected to be present in the environment. The data for TRS in this report does not include a CS_2 component.

Sulphur Dioxide

The sulphur dioxide instrument uses the same measurement principle as the TRS monitor. This instrument is Philips model 9700 unit. TRS is scrubbed out of the incoming air. The Air Resources Branch of the Ministry of the Environment has conducted extensive interference tests for this monitor (AQM/IU/80-3). The results are tabulated in Table II.

Table II

Sulphur Dioxide Monitor Response to Interferences with TRS Scrubber

<u>Compound</u>	<u>Relative Response (%)</u>
Dimethyl Sulphide ($[\text{CH}_3]_2\text{S}$)	63.2%
Sulphur Hexafluoride SF_6	0%
Carbonyl Sulphide COS	0%
Methyl Mercaptan CH_3SH	0%
Ethyl Mercaptan $\text{C}_2\text{H}_5\text{SH}$	142.5%
Carbon Disulphide CS_2	0%
H_2S	0%

The two significant interferences, dimethyl sulphide and ethyl mercaptan, are present in very low concentrations compared to SO₂ and thus the actual monitor response is reasonably representative of ambient SO₂ concentrations.

Oxides of Nitrogen

The monitor used for this measurement is a TECO-14B analyser. This instrument operates via chemiluminescence. Briefly, when nitric oxide reacts with ozone the chemical reaction produces pulses of light which can be counted. This device measures nitric oxide (NO) directly, total oxides of nitrogen through the use of high temperature catalytic converters (NO_x) and nitrogen dioxide (NO₂) by subtraction of the NO component from the NO_x component.

Ozone

A Bendix ozone analyser employing chemiluminescence was in use in Cornwall for the period of this report. This device counts pulses of light produced by the gas phase reaction of ozone and ethylene.

Carbon Monoxide

Carbon monoxide is measured using a Bendix instrument. This instrument operates using the infra-red absorption properties of carbon monoxide. However, hydrocarbon compounds exhibit the same or similar infra-red properties. This means that ambient carbon monoxide levels are less than or equal to those indicated by the monitor. The monitor provides a conservative estimate of carbon monoxide concentrations in Cornwall.

2.2 FIXED AND DISCRETE MONITORING

The fixed and discrete monitoring classification includes samplers which collect integrated or time averaged samples (2 hour, 24 hour, 30 day, etc.) at permanently sited stations. In Cornwall MOE operates three stations utilizing this format. Parameters monitored include:

1. Total suspended particulate matter
2. Soiling index

Suspended Particulate Matter

Fine particles of smoke from combustion, dust from construction and grinding processes, and sand, dirt and dust from moving vehicles constitute what is termed suspended particulate matter. It is measured by the use of high volume sampling, i.e. drawing measured volumes of air through filters and subsequently weighing the material collected. The result is expressed in micrograms of suspended particulate per m^3 of air averaged over the sampling period which is normally 24 hours.

Soiling Index

Fine particulate can also be quantified by the coefficient of haze (COH), or soiling index measurement. Ambient air is drawn through a screen to remove larger particles and insects. The air is then passed through a circular area of filter paper at a known sampling rate for a 1 hour sampling period. This operation is repeated automatically on fresh areas of paper at equal time periods. The absorbance of the circular spots or stains is measured in comparison with that of the clean paper with a photometer using white light or light of wavelength of between 500-800 nm. For comparison purposes, the absorbance readings are reported in Coefficient of Haze (COH) units per 1000 feet of air sampled. This measurement is influenced by factors such as particle size and shape, composition, colour, etc. These factors make it

sensitive to environmental changes such as the increased use of wood for home heating. Either the 24 hour high volume filters or the exposed spots on the COH filter tape can be analysed for individual chemical compounds in order to identify some of the sources which contribute to particulate pollution.

Generally, past experience indicates that metal levels in ambient air are low in Cornwall and hence we currently monitor only for lead in high volume filters.

2.3 SHORT TERM DISCRETE SAMPLE SURVEYS

Generally these survey stations are established for a fixed survey period to assess a particular problem and are not considered permanent stations. These types of surveys encompass sampling techniques where integrated samples are collected. The loadings on a sampler are obtained over an extended period of time and the result is averaged for that sampling period.

Parameter surveys include:

1. Airbourne mercury (Hg).
2. Airbourne fluorides.
3. Vegetable plots and plant pathology (phytotoxicology).
4. Dustfall.

Airbourne Mercury

Sphagnum moss, a dry plant material, has a known affinity for mercury. Monthly or weekly deployment of a number of moss bags, e.g. bags constructed of a screen type material containing moss, and the subsequent mercury determination on the moss can indicate the presence of mercury contamination. A contamination gradient can be computed if the bags are

deployed in sufficient number. Concentrations of mercury in the air cannot be calculated with this method since there is no measure of active air volume to which the collector is exposed. However it can be very effective within its limitations to evaluate trends, sources and extent of contamination. Sphagnum moss bags are deployed by the Phytotoxicology Section of the Air Resources Branch, Ministry of the Environment.

Airbourne Fluorides

Three methods of determining airbourne concentrations of this pollutant are employed. Two are passive, like moss bags, and the other is similar to high volume sampling and is therefore active sampling.

The passive techniques are fluoride candles and vegetation testing. The fluoride candle is a chemically activated cartridge which has an affinity for fluoride. It is very similar to the mercury moss bag and suffers the same limitations.

Vegetation sampling involves both determination of the chemistry of plant growth in the presence of pollutants and assessment of the health, vitality and normality of plant growth in an area. Many plant species are sensitive to the effects of air pollution. The chemical composition of animal feed crops and human food crops can be measured for toxic components such as lead, fluoride, mercury and others.

These assessments are carried out by the Phytotoxicology Section of Air Resources Branch.

Dustfall

Dustfall is measured by exposing "jars" for 30 days and weighing the dust collected over the exposure period. Dustfall is expressed as $\text{kg/m}^2/30$ days.

The dust can be analysed for chemical content; however, the dust fall jars are plagued with problems such as bird droppings, dead insects, and fallen leaves making it very difficult to interpret the data.

2.4 MOBILE MONITORING

The Air Resources Branch of the Ministry of the Environment has considerable resources devoted to mobile air monitoring. Vehicles are equipped with continuous analysers and can bring the equivalent of a fixed monitoring station to any location. Of particular interest is the Trace Atmospheric Gas Analyser (TAGA) which is equipped for extreme low level detection of many compounds. It is used across the Province in both regular survey work and in emergencies. In Cornwall mobile surveys were conducted yearly and reports have been issued on their findings.

3.0 POLLUTANTS, PROCESSES AND LOCAL SOURCES

3.1 TOTAL REDUCED SULPHURS (TRS)

TRS compounds (hydrogen sulphide, carbon disulphide, carbonyl sulphide, dimethyl disulphide, methyl mercaptain and others) are a very odourous class of air contaminants present in the Cornwall area. The most common of these is hydrogen sulphide which is a toxic gas with a pungent odour characteristic of rotten eggs. Hydrogen sulphide is toxic at concentrations greatly in excess of those found in ambient air. The other compounds, organic sulphides including mercaptans, are less

toxic than H_2S but have very unpleasant odours, noticeable at extremely low concentrations. These compounds are often present in the immediate vicinity of refineries, sewage treatment plants and pulp mills but are transformed in the atmosphere to oxidized sulphur compounds and hence decline rapidly in concentration with distance from the source. This oxidation process is also accelerated by the presence of oxidants such as ozone.

There are two major manufacturing operations in Cornwall where reduced sulphur compounds are produced as a consequence of the manufacturing process employed. One of these is in the west end of town, Domtar Fine Papers Limited, and the other is in the east end of town, Courtaulds Canada. Other less significant sources are CIL and BCL Canada.

Reduced sulphur pollution levels in Cornwall are assessed by comparison with the kraft pulp mill provisional guideline of 27 ppb if the wind direction is such that the measured concentrations can be related to a kraft mill operation, e.g. Domtar and by comparison with the ambient air quality criterion of 20 ppb for all other sources.

Domtar operates a Kraft paper mill which uses sodium sulphide in the wood digestion stage of the process. During this digestion, organic sulphur compounds and hydrogen sulphide are formed by the reaction of sodium sulphide with organic compounds contained in the wood. The majority of these sulphides are destroyed by a thermo-chemical recovery process which regenerates the pulping chemicals for re-use. Another large portion of these sulphides are oxidized to sulphur oxides and vented through a tall stack to minimize local impact. Some of these compounds do escape destruction and provide the immediate area of the Domtar mill with a characteristic odour of a Kraft mill. Process upsets in the mill occasionally allow large quantities of sulphides to enter the environment and a continuous monitor has been placed in a

location suitable for recording these occurrences. It is referred to as the St. Francis Station (56068). Documentation provided by this monitor has formed the basis for a plan of emission reduction. The St. Francis Station data are telemetered to the control room of the mill so that the operators can react quickly to TRS episodes measured at this station.

Courtaulds operates a cellulose products (viscose) manufacturing plant in the east end of Cornwall. This plant uses carbon disulphide in the process. Some carbon disulphide is lost to byproduct reactions which generate hydrogen sulphide and trace organic sulphides. Streams rich in these vapours (CS_2 and H_2S) are collected and oxidized before discharge to the atmosphere. Dilute sources are emitted without treatment and these emissions generate complaints and can be measured on the Memorial Park monitor under appropriate wind conditions. A continuous TRS monitor was installed at St. Peter's School in 1985 in the vicinity of the Courtaulds plant (56071) to assess the impact of emissions from this source. This monitoring data does not form part of this report.

3.2 SULPHUR DIOXIDE (SO_2)

Sulphur dioxide is a major atmospheric pollutant and has been documented in texts and other literature to have adverse effects on human health, vegetation and property. It is also a major contributor to the formation of acid precipitation. Sulphur dioxide is generated by fossil fuel combustion. It is also produced by industrial processes such as pulp and paper making. Sulphur dioxide production from thermal oxidation of TRS compounds is a standard means of controlling of reduced sulphur emissions. Ontario has three regulations for sulphur dioxide concentrations. The one hour average

air quality criterion (AAQC) is 0.25 ppm. The 24 hour AAQC is 0.10 ppm and the yearly average air quality criterion is 0.02 ppm by volume.

3.3 OXIDES OF NITROGEN

Nitrogen and oxygen, the principal constituents of the atmosphere, combine during high temperature combustion to form nitric oxide (NO) and nitrogen dioxide (NO₂). Combined, these gases are conveniently referred to as NO_x. The main local source of NO_x in Cornwall is automobile exhaust.

Nitrogen oxides are components of acidic precipitation and long range transport. These compounds play an important part in the photochemical reactions involving ozone (and other oxidants) and hydrocarbons. Nitrogen dioxide is known to affect health at concentrations which greatly exceed those found in the environment. Ontario has no nitric oxide standard. The ambient air quality criteria for nitrogen dioxide are 0.2 ppm for one hour and 0.1 ppm for 24 hours.

3.4 OZONE

Ozone occurs naturally and beneficially in the upper atmosphere. In the lower atmosphere however it is a product of sunlight-induced (photochemical) reactions involving reactive hydrocarbons and nitrogen oxide. Maximum concentrations of ozone are usually found at some distance from the area where its precursors, reactive hydrocarbon and nitrogen oxides, are produced. Thus high ozone concentration can often be found in locations where other parameters indicate very good air quality. Ozone is harmful to plant species and shortens the useful life of materials particularly rubber compounds. People with respiratory problems experience breathing difficulty when ozone concentrations exceed 0.1 ppm.

Ontario's one hour average ambient air quality criterion for ozone is 80 ppb.

3.5 CARBON MONOXIDE

In terms of concentration, carbon monoxide is a leading contaminant in city air. It can be produced by almost any flame or combustion device; however motor vehicles are almost exclusively responsible for the concentrations observed in urban air monitoring stations. Temporary impairment of function has been observed in human subjects exposed to carbon monoxide concentrations of 50 ppm, a level which can be reached in some urban areas.

Ontario has two ambient air quality criteria for carbon monoxide - an eight hour average of 13 ppm and a one hour average of 30 ppm.

3.6 FLUORIDES

Fluorides are commonly produced in brick manufacturing, glass production and the aluminium refining and reduction process. While fluoride is added to water in many communities to strengthen teeth, excess concentrations may cause fluorosis which can damage teeth. Fluoride deposition on grazing fields can be injurious to cattle and can damage sensitive plant species. Ontario has criteria for fluoride content in forage and for fluoridation rate. The fluoridation rate criteria are 40 ug/100 cm²/30 days (growing season) and 80 ug/100 cm²/30 days (non growing season).

The major sources of fluorides in the Cornwall area are Reynolds Metals Incorporated and the Aluminum Corporation of America (ALCOA) which operate in Massena, New York. The main

impact area of their collective operations is Cornwall Island which is under the jurisdiction of the Government of Canada.*

Fluoride emissions from aluminium reduction plants are produced in the electrolytic cells where aluminium oxide is reduced to the metal. Fluoride salts are added to the cell charge to act as an electrical conductor. The molten material in the cells volatilizes a portion of this fluoride. Air from the immediate cell area must be cleaned to remove these fluorides before it can be vented to the atmosphere. Most of the fluoride in this air is trapped and returned to the process minimizing the amount of fluoride salts which must be purchased. The fluoride which escapes to the atmosphere is a measure of the efficiency of this process.

3.7 MERCURY

Mercury is a well documented toxic metal used in large quantities in Cornwall since the 1920's. The major user of mercury in the Cornwall area is CIL.

CIL operates a mercury cell chlor-alkali plant and produces chlorine and caustic soda. The plant also operates a device called a Retort which extracts mercury from process wastes for reuse in its process.

Ontario's 24 hour average ambient air quality criterion for mercury is 2.0 ug/m^3 .

*The Ontario Ministry of the Environment participates in a joint fluoride monitoring program with the Government of Canada. Our component consists of annual phytotoxicology surveys and the Government of Canada operates a sequential fluoride sampling network.

3.8 CHLORINE AND CHLORINE DIOXIDE

Chlorine is used in the bleaching of paper products. In Cornwall the major emitter of chlorine and chlorine dioxide is Domtar Fine Papers Limited. CIL has a large chlorine inventory on-site. For the period covered by this report, continuous monitoring for these compounds was not feasible at ambient levels, but occupational monitors exist and are in use in both plants. A device for ambient monitoring has been purchased for installation in Cornwall for the spring of 1987.

4.0 DATA ANALYSIS

4.1 STATISTICAL OVERVIEW

The process of statistical inference is intended to provide insight that supports decision. Although decisions are made that are based on both subjective and objective data, the mathematics of statistics is often cited as the basis for decision. The data in this report was analysed by several methods. When different methods give similar results, the analyst can be more confident in interpretations. When different techniques suggest opposing or uncertain results, the analyst should be cautious in the interpretation. Many statistical tests are based upon theoretical assumptions regarding data. These assumptions can now be examined routinely with statistical software which is commercially available. Extensive use has been made of SAS (statistical analysis system), version 82.3 and Version 5 produced by the SAS Institute in this report.

4.1.1 Parametric/Non-Parametric Test Methods

The information in this report represents millions of individual air quality observations. Some form of data reduction is required to allow interpretation of such a

volume. The technique used to achieve this reduction can often influence conclusions reached.

Most of the statistical methods in common use are derived from the study of random variables. Most of these methods are designed for tests of significance of random independent data derived from a Normal distribution. This provides two points for discussion. The first is randomness and independence and the second is normality.

Pearson et.al. (6), defines randomness as, "the intuitive idea that several determinations of a number are unrelated or have no effect on each other." This definition generally applies to repeated measurement of one item, for example the diameter of a ball bearing. Another such application would be the diameters of ball bearings produced by one machine in one production run.

This definition cannot be applied to air pollution measurements taken sequentially in time. The chart recording produced by a monitor is essentially continuous. Mathematically this indicates that derivatives can be computed. The existence of a derivative is in direct opposition to the nature of an independent random variable. Therefore the body of data collected with a continuous air monitoring station is not a collection of independent random samples.

Normality describes the distribution of random samples. Snedecor and Cochran (7), describes the Normal or Gaussian distribution. Normality is a mathematical prerequisite in the theoretical derivation of many of the commonly employed techniques of statistical inference. For example Mendenhall (8), describes the conventional T test as derived for random, independent and normally distributed data. T tests, F tests and other methods comprise parametric statistical inference.

The process of parametric statistical inference is the comparison of data to a theoretical distribution. Means, deviations and other terms are elements of this class of statistics - Appendix T1.1. For example the mean is a parameter describing the central tendency of a set of observations. The deviation is a parameter describing the scatter of these values about the mean. The significance of differences in these parameters infers differences in the measurements. If a suitable theoretical distribution cannot be found then a serious problem is encountered (9) (10) (11) (12) (21).

The most common theoretical distribution used is the gaussian or normal distribution. Extensive documentation is available on this distribution (13) (14) (15). The Gaussian theory can be successfully applied providing certain assumptions are satisfied. These statistics can often be successfully applied even when some assumptions are only weakly satisfied or not satisfied at all. The robustness problem i.e. immunity of results to assumptions is a serious one. If data are not normally distributed and in fact are not expected to be normally distributed, then conventional techniques based on the assumption of normality must be used with caution.

The normality of a data set can be judged. A model of the data using the normal parameters can then be compared to the actual data to estimate the goodness of fit. A pragmatic approach is to determine if the Normal representation can reproduce the data set with reasonable accuracy.

A comparison of the nature of air pollution and the properties of the normal curve serve to illustrate the difference between observation and theory. Air pollution concentrations can never be less than zero, whereas some data of the normal distribution are less than zero by definition. The coef-

ficient of variation is a rapid estimator of the probability of negative observations. Since no negative values can be encountered in the real world, the more that are predicted, the poorer the model.

An exact theoretical calculation of the probability of negative values for a given data set is possible (16) (17) (18) (19). By definition 68% of the observations will be within plus or minus one standard deviation of the mean. 95 % of the observations will lie within 2 standard deviations of the mean and 3 standard deviations should contain 99.7% of the observations. Figure A2.1 depicts a sample Normal distribution. In this figure the area to the left of the vertical references translates into a theoretical probability of values less than this magnitude. An expectation value of 1% negative values indicates 1 out of 100 observations should be negative. However, air pollution concentrations are not negative. While this is not a totally improbable situation, when millions of data points are collected and theory says tens of thousands should be negative there is a drastic conflict between the mathematics and physical reality. In this sense, a large amount of accurate data strictly limits the use of a normal model to represent air quality data.

Looking at annual blocks of data, Cornwall air quality coefficients of variation (ratio of standard deviation to the mean) as high as 170% have been experienced (1983 H₂S data, Station 56051). Using standard probability theory, this data set yields a probability of a 1 in 5 chance of observing negative values, e.g. one would expect 1750 negative values for the yearly data set (refer Figure A2.1). Therefore the use of a normal approximation to the air pollution survey data is inappropriate and any tests based on normal distribution estimators are of questionable value.

The Lognormal model has achieved widespread success for air pollution statistics as a solution to this problem. In the Lognormal distribution, the logarithms of the observations follow the Normal distribution. Zero values are not possible and hence the approach cannot be used for data sets which include zeros, e.g. total reduced sulphur (TRS) observations which are zero approximately half the time in Cornwall. Therefore it is found to be unsuitable for Cornwall TRS data. Ozone concentration is practically never zero. Ozone is associated with long range transport and is expected to be uniformly mixed over a larger area than the emissions of a nearby stack. The Lognormal model may apply to ozone, but may not be used for locally produced pollutants, such as TRS.

If a suitable distribution cannot be found then different techniques are indicated. For the purposes of this report the alternative chosen is distribution-free or non-parametric statistics. This technique involves a more empirical approach and can produce equivalent results to normal theory when applied to normal data. Methods involving normal theory applied to non-normal data may not agree with non-parametric results (20).

4.1.2 Homogeneity/Stratification

Homogeneity is implicit in the derivation of most statistical tests. This means, in its most simplified form, that analysis of mixed populations is to be avoided. An examination of a real situation may provide clues that can be used to stratify the data into smaller manageable sub-groups. It may be found that a sub-group can satisfy the requirements for normal parametric statistics.

In an area where point sources of air pollutants exist, it is apparent that the concentrations measured at one location will depend on wind direction as well as many other factors, many of which are extremely difficult and costly to monitor. This dependence suggests that the data is inhomogeneous and should be stratified.

Different groups of data may also have different sets of controlling or influencing factors for a common object of study. Separation and individual analyses enables the appropriate factors to be applied only to the correct sub-group.

Measured concentrations are directly affected by factors such as changing wind patterns, industrial activity, local weather and atmospheric structure. Measured trends or lack of trend may be a reflection of change in any or all of these factors. While the data set might be stratified for any/all of these factors in Cornwall, the only factors for which adequate, accurate data are available is wind speed and direction. For purposes of this report stratification is only attempted with respect to wind direction and speed.

4.2 METHODOLOGY

The physical nature of air pollution disagrees with much of the theoretical basis for parametric statistical inference based on the theory of random variables. Continuous air pollution measurements are related in a time series and are not random, or independent. In general, it can be shown that the data is not Normally distributed. Descriptive statistics can be computed and reported but may not generally be usable in tests of statistical significance. Source-specific pollutants are also not lognormally distributed while long range transport air pollutants may be distributed in this manner.

An empirical approach based on measurable differences between bodies of data is indicated. Due to the dynamic and episodic nature of air pollution, reasonable approaches may include stratification schemes, cluster analysis and tests based on empirical distribution functions.

Due to the potential problems regarding parametric statistical inference for the air quality survey data, normal methods and non-normal methods will be compared for each pollutant on a descriptive basis. The entire data set for each contaminant will first be analysed and then stratification will be employed when appropriate. The data will be compared to theoretical models and will be subjected to deeper scrutiny by other means if Ontario criteria have been exceeded.

4.3 EVALUATION OF CONTINUOUSLY MONITORED POLLUTANTS

Tables A1, and Appendices F1 and F2 contain the yearly data summaries for each pollutant spanning the period 1980 to 1984. Appendix T1.1 contains a glossary of terms.

4.3.1 Total Reduced Sulphurs (TRS)

TRS is a primary air pollution concern in Cornwall. While concentrations have never approached toxic levels, the recorded concentrations for this class of pollutants in Cornwall are among the highest in Ontario and the eastern part of Canada. (1)

For the purposes of this report, yearly TRS data sets will be evaluated in comparison to the Kraft Mill Guideline of 27 ppb because there is a kraft mill in Cornwall (Domtar) which impacts on the air quality monitoring stations. In essence

(refer to Tables A1.1 and A1.2), evaluation of yearly TRS data sets show a significant number of hours in excess of the kraft mill provisional guideline of 27 ppb at both stations. The actual number of hours in excess of the Kraft Mill Guideline for station 56051 are 26, 44, 78, 81, 60 for 1980-84. The data sets for 1980-84 (Tables A1.2) at station 56068 show similar trends; however the 99th percentile is approximately 31 ppb. At this station, higher values are observed more frequently yielding 85, 106, 169, 83, 89 hours over the kraft mill provisional guideline for the years 1980-84. In section 3.3 an attempt is made to attribute violation responsibility to individual sources.

The yearly data sets for the two stations (56051 and 56068) have been examined with respect to normal distribution parametric descriptors such as coefficient of variation, skewness and kurtosis. With reference to Table A1.1 it is noted that coefficient of variation is not less than 100% for any of the data sets. This magnitude of coefficient of variation predicts a minimum of 38% negative values or 3306 hours of negative values per year per station. Similarly, the skewness ranged from 8 to 2; however the expected skewness of a normal distribution is zero. Lastly the kurtosis ranged from 9 to 150 as compared to an anticipated value of 3. This lack of agreement between theoretical and calculated descriptors is not unexpected considering the potential for plant upsets and variation in emission levels over a year, the local wind specific orientation of the sources and fluctuating weather patterns. It is abundantly clear that the TRS data sets are inhomogeneous and non-normal. Considering the high incidence of zero values, log-normal statistical inference equally does not apply to the TRS data sets. This evaluation shows that TRS data sets do not conform to the requirements for parametric statistical inference and indicates that the approach

is not valid for TRS data sets and in general may not be valid for local source pollutants in a continuous monitoring environment. Thus normal tests for significance are of questionable value and should only be utilized in a broad qualitative sense of descriptive nature.

The % valid data for TRS at 50561 and 56068 on a yearly basis ranged from 91 to 98 and averaged 96%. The variation in % valid data will not affect the lower yearly percentile values however may have had an effect on the 99% value and thus the values of the 99 percentile in ppb can be compared only in a qualitative fashion.

With reference to Table A1.1 and Plots F1.1 it is observed (exclusive of the 1983 data) that the median stays constant and overall decreases are noted for the 75th through 95th percentiles. This indicates generally improved air quality. It is also shown in increased number of hours of zero TRS concentration.

Evaluation of the yearly blocks of data demonstrate significant continued exceedances of the Kraft Mill Provisional Guideline. A trend of slight overall improvement may exist. Finally, statistical inferences of the ambient air concentration data utilizing the Normal distribution are difficult to justify.

Table 3.2

		<u>MODE Analysis</u>				
		<u>Year</u>				
<u>56051</u> (Memorial Park)	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	
# of hours TRS = 0 ppb	4771	5193	4497	2796	5871	
Zero hours As a percentage of data	55.3	60.3	52.8	35.0	68.2	
<u>56068</u> (St. Francis School)	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	
# of hours TRS = 0 ppb	2652	3442	2446	3652	3420	
Zero hours As a percentage of data	34.1	43.8	29.3	42.6	45.5	

Refer to Appendix F2.1 and F2.2 for multi-year plots of the yearly frequency distribution.

4.3.2 Sulphur Dioxide

The overall properties of the yearly data sets for 1980-84 for station 56051 are depicted in Table A1.3 and plotted in F1.3 and F2.3. With reference to these tables it is noted that the hourly criterion was exceeded only five times and the 24 hour and yearly criteria were never exceeded indicating generally good to very good air quality with respect to SO₂.

The relative consistency of the percentile levels and the frequency distribution indicate no apparent trend towards either improving or deteriorating air quality. This is particularly noted in the 3-dimensional plot in F2.3.

Similarly to the TRS yearly data set evaluations, the comparison of the theoretical and calculated statistical descriptors indicates the non-normality of the SO₂ data sets.

4.3.3 Carbon Monoxide

With reference to Table A1.4, it is noted that carbon monoxide never exceeded Ontario's one and eight hour criteria of 30 and 13 ppm. Occasional elevated observations can be attributed to motor vehicle activity. The mode has decreased from one to zero over the period 1980 to 1984. In general air quality is excellent with respect to CO. Refer to F2.4 for the five year analysis.

4.3.4 Oxides of Nitrogen

Ontario has no regulation for nitric oxide and total oxides of nitrogen. The data is summarized in Tables A1.5 and figure F1.5-7 and F2.5-7. The NO and NO_x levels concentration data had very low means and modes.

NO₂ levels (refer to Table A1.5) are entirely within Ontario's criteria of 0.20 ppm for one hour for the entire five year period. The maximum observed one hour average value was 0.11 ppm.

4.3.5 Ozone

Ozone is considered to be a pollutant with both local and long-range transport aspects.

With reference to Table A1.8 it is noted that ozone levels exceed Ontario's one hour ambient air quality criterion of 80 ppb upon occasion particularly during the summer months. Actual number of hours exceedance ranged from 14 to 47,

averaging 30 hours per year. While there have been occasional exceedances of the criterion, there has been no confirmed evidence of vegetation damage associated with ozone detected in the Ministry's phytotoxicology evaluations in the Cornwall area. Many of these occurrences are associated with southerly winds indicating sources within the United States.

The measured variation is almost acceptable for normal sampling theory and the very low (relatively speaking) occurrence of zero admits the possibility of the use of log normal models. This reflects the long range transport aspect of ozone. In the absence of local sources the steady state, long range transport component is present. The main problem with this data is its known non-randomness or time series nature. The numbers are "well behaved" but the use of the theory of random variables for non-random data is suspect.

With respect to Table A1.8 and figures F2.8 and F1.8, it is noted that the calculated coefficient of variation, skewness and kurtosis values are close to theoretical values and thus the use of parametric statistics to represent the ozone data set is acceptable. In this regard no significant trend is depicted by either the percentile groupings or variations relative to the mean, mode or median over the five year period.

4.3.6 Soiling Index (COH)

The soiling index in Cornwall occasionally exceeded the Ontario ambient air quality criterion of 1.0 COH unit. Actual exceedances ranged from 51 hrs/year to 87 hrs/year. There are occasional inversion episodes in Cornwall which hinder dispersion of particulates and result in elevated COH values. More significance should be attributed to the number

of episodes than the total number of hours involved; however, this is simply a reflection of the incidence of inversion conditions. Generally COH values are low and represent good air quality conditions with respect to fine particulates.

4.4 SOURCE APPORTIONMENT (Station 56051)

Sorting and classifying data into appropriate sub-groups is a well-documented analytical practice. Techniques such as principal component analysis and analysis of variance are available in many computer software packages. These techniques are also dependent on the assumption of randomness.

For this report TRS data was stratified into four "sources"; 1) Domtar, 2) Courtaulds, 3) Other, and 4) Unknown. The Unknown source includes observations that cannot be positively put into one of the other three groups. For example, if the wind velocity is too low for an accurate wind direction measurement.

Wind direction was parcelled into 16 groups representing 16 points of the compass, e.g. N, NNE, etc. Categories were then assigned to sources where the stack and fugitive emissions from the source would likely reach the monitors. It was fortunate that the monitoring stations lie approximately mid-way between the two sources allowing reasonable resolution.

Actual source designation is defined by Table 4.4.1.

Table 4.4.1

Source Assignment

<u>Source Name</u>	<u>Factor List</u>
Domtar	Wind Direction = W, WSW, SW
Courtaulds	Wind Direction = E, ESE, ENE
Unknown	Wind Speed less than or equal to 4 km/hr or direction data missing
Other	Not in the above

For the first analysis, hours with wind speed of four kilometers per hour or less were deemed unknown source. Clearly the results will be sensitive to the exact criterion chosen for stratification. The higher the criterion the greater the number of hours placed in the unknown category; however, if the criterion is too low the risk of falsely identifying sources increases.

For each source, analysis can now be carried out as for the pooled data in the previous section. In general, stratification schemes improve analytical results at the expense of complexity, definition and sorting input required. Tables A2.0 and F2.0 of the frequency data for each of the four sources for the periods 1980 to 1984.

With respect to Tables A2.0 to A2.8 it is clear that a number of hours of data attributed to Domtar exceeded the kraft guideline of 27 ppb. The actual number of hours were 45, 22, 20, 27 and 3 for 1980, 1981, 1982, 1983 and 1984. Further, by making inter-year comparisons, it appears that while there has been fluctuations as shown in F3.1, with 1983 being the worst with respect to lower values there appears to be a general trend towards improved compliance. This may simply indicate normal yearly fluctuations or the beginning of a trend. There is clear evidence that Domtar's impact with respect to hours over 27 ppb was substantially reduced between 1980 and 1981 and further reduced between 1983 and 1984. Continued monitoring will confirm whether these are actual changes in impact associated with abatement programs or simply year to year fluctuations associated with other variables, e.g. wind speed, production, occurrence of various stability classes, etc.

With respect to Tables A2.2 and Figures F3.2 representing the Courtaulds source, it is clear that a number of hours of data attributed to this source exceeded the criterion of 20 ppb. Actual hours 23, 38, 32, 24, 22. It appears that the impact on this station due to low value concentrations associated with Courtaulds has remained relatively constant, e.g. values less than or equal to 5 ppb have remained relatively constant at approximately 80% of the total hours attributed. For reference purposes, 5 ppb is considered the Hydrogen sulphide odour threshold. The actual number of hours when odour would not be detected at the station was 769 hours from 1980 to 1211 in 1982 and dropped to 924 hours in 1983 and then down to 798 in 1984 (e.g. total hours - hours greater than 5).

Percentage occurrence of higher values of TRS (H_2S greater than 20 ppb) average 2.4% of the hours clearly attributable to Courtaulds but has increased since 1982.

<u>Year</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
% of hours greater than 20 ppb attributed to Courtaulds	2.6	2.9	1.7	3.3	3.6

Table A2.3 and Figure F3.3 represent the data attributed to the unknown source. As noted data is attributed to this source if the wind speed is less than 5 km/hour. This data cannot be attributed to any source and no analysis has been attempted at this time.

Table A2.4 and Figure F3.4 represent the impact of the "Other" source on Station 56051.

The impact on air quality associated with this source due to low concentrations was fairly consistent with the exception of 1983. Similarly high values associated with this source were very low from 1980 through 1981, however increased significantly in 1982 and returned to low levels in 1983 through 1984.

There are three possible explanations for sources associated with this grouping. Firstly, these could be other significant contributors of TRS within the points of the compass associated with this group; however to the best of our knowledge there are no such sources. Emissions from CIL could have impacted in this group more than anticipated by the nature of its operations. An analysis of this possibility will be completed separately. The third factor, the probable explanation, is changing weather patterns, e.g. gradual wind direction changes during the hour or sudden wind direction changes due to front passage, cause overlap of source categories in the attempt to identify source specific (Domtar, Courtauld) impact in a conservative fashion. Thus while these impacts are not associated directly with major sources in Cornwall, it is highly probable that they are due to these sources although our data base is inadequate to properly apportion the impact to the sources.

To evaluate the appropriateness of the approach, further evaluations have been completed with respect to wind speed cutoff. The wind speed was altered from 4 to 2 km/hour to assess apportionment between Other, Domtar and Courtaulds. The results of the impact assessment with these altered assumptions are in Table A6.1 and graphed in F4.3.

The impact of reducing the cutoff and wind speed from 4 km/hour to 2 km/hour is to reduce the number of hours in unknown, e.g. hours with wind speed between 2 and 4 km/hour have to be apportioned among Courtaulds, Domtar and Other sources. It is noted that this reduces the unknown hours between 600 and 900 hours per year. For those hours with concentrations greater than 20 ppb, it is apparent that the apportionment is predominantly to Courtaulds and Domtar as opposed to Other. This simply demonstrates the conservativeness of the approach for high value concentrations. A similar pattern can be demonstrated with respect to hours greater than 27 ppb.

Table IIIHours Greater than 20 ppb over 1980-84

<u>Source</u>	<u>4 km/hour</u>	<u>2 km/hour</u>	<u>Delta %</u>	<u>Delta N</u>
Courtaulds	168	190	13%	22
Domtar	229	257	12%	28
Other	119	136	14%	17
Unknown	132	100	-25%	-32

Station 56068 data is presented in Tables A2.4-8 and A6.4-8. This data is similar to that from 56051 except primarily for hours greater than 20 ppb attributed to Domtar. Higher values from this source occur twice as often as at 56051. The impact of Courtaulds on this station is lessened.

The two major industrial sources in Cornwall have had a continual detrimental impact on the quality of the Cornwall airshed. Source apportionment using computer analysis with a predetermined stratification scheme can provide a standardized format for long term assessment. Exact stratification schemes can be devised using meteorological data. Company reporting of upset conditions could be merged into the data to qualify the analysis. The conclusions drawn can also be examined for sensitivity with respect to the classification scheme.

AQI and Total Reduced Sulphurs

The Air Quality Index system will report air pollution incidents in real time. This will focus considerable public attention upon industrial sources, particularly in the Cornwall area. This will probably increase the frequency of complaints. Effectiveness of control strategy should not be judged by the increase or decrease of the rate of complaint. Mathematical modeling, source emission monitoring, and routine monitoring of pollutants and meteorology must all be used to measure year to year changes in the quality of the Cornwall airshed.

4.5 EVALUATION OF INTEGRATED SAMPLES DATA (TOTAL SUSPENDED PARTICULATES)

Total suspended particulates (TSP) are measured at two locations in Cornwall, stations 56051 and 56070, (Map M1.2). Total suspended particulates data for these stations is summarized in Tables A7.1. For both of those stations, TSP and lead concentrations are well below the Ontario Ambient Air Quality Standards for total suspended particulates and lead of 120 mg/m^3 and 5 mg/m^3 .

4.6 FLUORIDES

Determination of airborne fluorides using passive collectors such as fluoride candles provide much less information than active monitors (the continuous or sequential). The loading on these candles is accumulated over a 30 day period. There are at most 12 data points per year as compared with 8,000 or more for a continuous monitor. Table A5.1 contains the fluoridation rate data for the Cornwall area. The Ontario Growing Season criterion of $40 \text{ ug/100 cm}^2/30 \text{ days}$ was frequently exceeded at stations on Cornwall Island close to the aluminium reduction plants. Accompanying surveys on Cornwall Island, conducted by the Phytotoxicology Section of Air Resources Branch, show marginal vegetation damage and only slightly elevated levels of fluoride in some plant species. A Federal Government sponsored study (21) on the human health effects of fluoride emissions was conducted in 1982 and a summary report has been issued on the findings of that study.

The scatter of the fluoride candle data is sufficient to obscure any realistic trend interpretation of candle data. The use of passive monitors on Cornwall Island was discontinued in 1982 and the assessment of the fluoride impact

is now based on the results of annual phytotoxicology surveys and Federal monitoring. The Federal government operates a sampling network under the auspices of the Environmental Protection Service. This network collects daily gaseous and particulate fluoride samples. The sample results are tabulated and published yearly by the Environmental Protection Service and can be source related.

5.0 AIR QUALITY INDEX

The Air Quality Index is a Province-wide, real-time air quality reporting system. Each pollutant measured at a station has a piece-wise linear equation translating concentrations in the air to one of the following categories: very good, good, moderate, poor, and very poor. These designations are related to levels perceived by the general population as ranging from pristine to nuisance. They also relate to the Ontario air quality objectives and standards.

An index system has been devised to present the various readings of all continuous monitoring data. An index is a mathematical standardization. For example, ozone is present at parts per billion, sulphur dioxide at parts per 100 million, and carbon monoxide at parts per million. Each has different levels of toxicity, hazard or nuisance. An index reduces all of them to a common range which is generally 0 to 100.

Air quality sub-indices have been computed using the design equations for the data used in this report. The main contaminant of concern is TRS. Ozone will occasionally produce elevated indices as shown in the following table.

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION
POLLUTANT CONCENTRATIONS EXPRESSED AS AQI SUBINDICES

TABLE OF OZONE BY YEAR

OZONE(OZONE PARTS PER BILLION)		YEAR				
FREQUENCY	PERCENT					
ROW PCT	COL PCT	1980	1981	1982	1983	1984
COL PCT						
VERY GOOD		7803	8069	8149	8059	7802
		18.58	19.21	19.40	19.19	18.57
		19.57	20.23	20.43	20.21	19.56
		95.07	95.87	96.54	94.48	92.78
GOOD		341	335	279	424	588
		0.81	0.80	0.66	1.01	1.40
		17.34	17.03	14.18	21.56	29.89
		4.15	3.98	3.31	4.97	6.99
MODERATE		64	13	13	47	19
		0.15	0.03	0.03	0.11	0.05
		41.03	8.33	8.33	30.13	12.18
		0.78	0.15	0.15	0.55	0.23
TOTAL		8208	8417	8441	8530	8409
		19.54	20.04	20.10	20.31	20.02
						42005
						100.00

FREQUENCY MISSING = 1843

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)		YEAR				
FREQUENCY	PERCENT					
ROW PCT	COL PCT	1980	1981	1982	1983	1984
COL PCT						
VERY GOOD		7211	7822	7671	6453	7868
		17.03	18.48	18.12	15.24	18.58
		19.48	21.13	20.72	17.43	21.25
		83.63	90.83	90.09	80.87	91.39
GOOD		774	441	486	948	355
		1.83	1.04	1.15	2.24	0.84
		25.77	14.68	16.18	31.56	11.82
		8.98	5.12	5.71	11.88	4.12
MODERATE		554	297	297	497	357
		1.31	0.70	0.70	1.17	0.84
		27.67	14.84	14.84	24.83	17.83
		6.43	3.45	3.49	6.23	4.15
POOR		83	52	61	81	29
		0.20	0.12	0.14	0.19	0.07
		27.12	16.99	19.93	26.47	9.48
		0.96	0.60	0.72	1.02	0.34
TOTAL		8622	8612	8515	7979	8609
		20.37	20.34	20.11	18.85	20.33
						42337
						100.00

FREQUENCY MISSING = 1511

CONCLUSIONS - FUTURE MONITORING CONSIDERATIONS

A considerable expenditure of time and money has been made both to study sulphur compounds and to reduce the emissions of those compounds which have a noticeable impact on air quality in the City of Cornwall. The period covered by this report has not provided clear evidence that these efforts have resulted in a commensurate improvement in air quality. What has been gained, however, is a better understanding of the problems associated with regulating and monitoring sulphur compounds.

A full explanation of this topic would add greatly to the length of this report, but briefly stated, there exists in Cornwall two types of sulphur compounds with a ten-fold difference in their allowable ambient air concentrations. While the TRS data obtained for this report was obtained with a monitor which is insensitive to carbon disulphide, the monitors in current use respond to carbon disulphide as well as to the sulphides and mercaptans which are regulated as TRS.

With the replacement of the obsolete monitors, we are now faced with the task of measuring the carbon disulphide component of Cornwall ambient air in order to correct our TRS readings to reflect the actual concentrations of TRS. A strategy has been implemented to monitor carbon disulphide and TRS separately and, if successful, this strategy will allow a better assessment of source contributions to Cornwall's air quality.

One of the difficulties encountered in assessing air quality in Cornwall is the lack of information on meteorological parameters such as: wind speed and direction and air temperatures. Installation of a new telemetry system in

Cornwall in 1987 will enable us to obtain up to the minute meteorological information to evaluate the matching "real time" monitoring data of pollutant concentrations.

All of the source specific data interpretations developed in this report have been done on the basis of historical records obtained from charts of met data which were read up to several months after the date of occurrence. While this constitutes acceptable practice, it does not allow on site verification of reported conditions.

An air quality problem in Cornwall which has been identified, but not evaluated is the presence of noticeable concentrations of chlorine gas. Chlorine is produced by CIL and used by Domtar and is occasionally noticed in the west end of Cornwall in the vicinity of these industrial plants.

An air monitor to measure ambient concentrations of chlorine has been purchased and, when delivered, will be used to measure chlorine concentrations in the west end of Cornwall. Information obtained from this monitor will be used to develop emission controls, if required.

GRAPHS AND TABLES - SPECIAL NOTE

SOFTWARE TRUNCATION OF CERTAIN CHARACTER LITERALS HAS
OCCURRED IN THESE SECTIONS.

FOR EACH POLLUTANT THE UNIT OF CONCENTRATION IS LISTED BELOW.
THESE ARE NOT THE MOST COMMON UNITS USED, BUT WERE SELECTED
SUCH THAT ALL MATHEMATICAL COMPUTERIZED STEPS WOULD BE IN
INTEGER ARITHMETIC.

TOTAL REDUCED SULPHUR	PARTS PER BILLION
SULPHUR DIOXIDE	PARTS PER 100 MILLION
CARBON MONOXIDE	PARTS PER MILLION
OXIDES OF NITROGEN	PARTS PER 100 MILLION
OZONE	PARTS PER BILLION

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNHALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT HYDROGEN SULPHIDE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8622.00	8612.00	8515.00	7979.00	8609.00
MEAN	2.76	1.84	2.03	3.38	1.59
STANDARD DEVIATION	5.75	4.92	5.01	5.82	4.38
COEFFICIENT OF VARIATION	208.58	267.24	246.50	171.94	275.41
VARIANCE	33.12	24.20	25.12	33.86	19.20
SKEWNESS	4.15	8.60	6.68	4.57	5.92
KURTOSIS	27.87	151.80	71.85	34.38	56.32
MAXIMUM	97.00	141.00	101.00	92.00	83.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	0.00	0.00	0.00	1.00	0.00
3RD QUARTILE	3.00	2.00	2.00	4.00	1.00
90TH PERCENTILE	9.00	5.00	5.00	9.00	4.00
95TH PERCENTILE	14.00	9.00	9.00	13.00	10.00
99TH PERCENTILE	27.00	22.00	24.00	28.00	20.00
MODE	0.00	0.00	0.00	0.00	0.00
% OF HOURS OVER CRITERIA	73.00	52.00	61.00	81.00	29.00

A 1.1

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=ST.FRANCIS SCHOOL

POLLUTANT HYDROGEN SULPHIDE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	7783.00	7858.00	8353.00	8572.00	7513.00
MEAN	4.32	3.11	4.52	2.73	3.51
STANDARD DEVIATION	7.92	6.25	7.47	5.59	6.26
COEFFICIENT OF VARIATION	183.34	200.97	165.09	204.90	178.18
VARIANCE	62.73	39.01	55.76	31.28	39.13
SKEWNESS	6.06	5.45	4.29	5.96	3.28
KURTOSIS	87.01	58.18	29.10	56.31	17.00
MAXIMUM	213.00	142.00	107.00	102.00	91.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	2.00	1.00	2.00	1.00	1.00
3RD QUARTILE	5.00	3.00	6.00	3.00	4.00
90TH PERCENTILE	12.00	8.00	11.00	7.00	11.00
95TH PERCENTILE	18.00	13.00	18.00	11.00	16.00
99TH PERCENTILE	37.00	31.00	36.46	27.00	29.00
MODE	0.00	0.00	0.00	0.00	0.00
# OF HOURS OVER CRITERIA	138.00	116.00	170.00	83.00	89.00

A1.2

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT SULPHUR DIOXIDE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8541.00	8433.00	8430.00	8355.00	8044.00
MEAN	1.18	0.98	1.05	0.83	0.99
STANDARD DEVIATION	2.01	1.69	1.75	1.68	1.64
COEFFICIENT OF VARIATION	170.26	171.36	167.17	203.50	165.73
VARIANCE	4.05	2.85	3.06	2.82	2.71
SKEWNESS	3.96	3.39	3.42	3.95	3.62
KURTOSIS	26.58	18.19	19.98	23.96	22.97
MAXIMUM	30.00	21.00	29.00	25.00	25.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	1.00	0.00	0.00	0.00	0.00
3RD QUARTILE	2.00	1.00	1.00	1.00	1.00
90TH PERCENTILE	3.00	3.00	3.00	2.00	3.00
95TH PERCENTILE	5.00	4.00	4.00	4.00	4.00
99TH PERCENTILE	9.00	8.00	9.00	8.00	8.00
MODE	0.00	0.00	0.00	0.00	0.00
# OF HOURS OVER CRITERIA	1.00	0.00	1.00	0.00	0.00

A 1.3

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT CARBON MONOXIDE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8317.00	8238.00	8553.00	8524.00	8279.00
MEAN	1.07	1.14	0.99	0.22	0.19
STANDARD DEVIATION	0.65	0.71	0.78	0.63	0.60
COEFFICIENT OF VARIATION	61.13	62.53	78.68	287.82	321.22
VARIANCE	0.42	0.51	0.62	0.40	0.37
SKEWNESS	2.24	4.87	2.76	4.20	7.43
KURTOSIS	14.14	46.79	18.64	25.75	98.39
MAXIMUM	8.00	12.00	12.00	8.00	13.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	1.00	0.00	0.00	0.00
1ST QUARTILE	1.00	1.00	1.00	0.00	0.00
MEDIAN	1.00	1.00	1.00	0.00	0.00
3RD QUARTILE	1.00	1.00	1.00	0.00	0.00
90TH PERCENTILE	2.00	2.00	2.00	1.00	1.00
95TH PERCENTILE	2.00	2.00	2.00	1.00	1.00
99TH PERCENTILE	3.00	4.00	4.00	3.00	2.00
MODE	1.00	1.00	1.00	0.00	0.00
# OF HOURS OVER CRITERIA	0.00	0.00	0.00	0.00	0.00

A1.4

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT NITRIC OXIDE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8548.00	8339.00	8522.00	8058.00	8067.00
MEAN	0.71	0.64	0.46	0.84	0.69
STANDARD DEVIATION	2.25	2.49	1.77	2.83	2.71
COEFFICIENT OF VARIATION	318.94	386.23	384.84	336.18	390.14
VARIANCE	5.06	6.20	3.12	8.00	7.35
SKEWNESS	7.97	8.03	7.44	6.66	10.05
KURTOSIS	91.92	83.98	76.31	60.17	143.99
MAXIMUM	44.00	45.00	33.00	48.00	60.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	0.00	0.00	0.00	0.00	0.00
3RD QUARTILE	1.00	0.00	0.00	1.00	0.00
90TH PERCENTILE	2.00	1.00	1.00	2.00	1.00
95TH PERCENTILE	4.00	3.00	3.00	4.00	3.00
99TH PERCENTILE	10.00	12.00	8.00	17.00	11.32
MODE	0.00	0.00	0.00	0.00	0.00
# OF HOURS OVER CRITERIA	0.00	0.00	0.00	0.00	0.00

A 1.6

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT NITROGEN DIOXIDE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8054.00	8381.00	8516.00	8456.00	7936.00
MEAN	1.10	1.12	1.00	1.07	1.10
STANDARD DEVIATION	1.11	1.10	1.12	1.14	1.24
COEFFICIENT OF VARIATION	100.26	98.47	112.44	106.18	112.42
VARIANCE	1.23	1.21	1.26	1.29	1.53
SKEWNESS	1.54	1.75	1.71	1.73	1.82
KURTOSIS	3.94	5.70	4.19	5.15	5.40
MAXIMUM	9.00	11.00	9.00	10.00	11.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	1.00	1.00	1.00	1.00	1.00
3RD QUARTILE	2.00	2.00	1.00	2.00	2.00
90TH PERCENTILE	3.00	2.00	2.00	2.00	3.00
95TH PERCENTILE	3.00	3.00	3.00	3.00	3.00
99TH PERCENTILE	5.00	5.00	5.00	5.00	5.00
MODE	1.00	1.00	1.00	1.00	0.00
% OF HOURS OVER CRITERIA	0.00	0.00	0.00	0.00	0.00

A1.6

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT TOTAL NITROGEN OXIDES

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	7981.00	8257.00	8434.00	7980.00	7574.00
MEAN	1.81	1.78	1.47	1.93	1.82
STANDARD DEVIATION	3.05	3.30	2.52	3.46	3.42
COEFFICIENT OF VARIATION	168.35	185.00	171.57	179.20	188.37
VARIANCE	9.31	10.89	6.35	11.95	11.71
SKEWNESS	6.07	6.41	4.91	5.08	6.82
KURTOSIS	62.80	61.30	38.04	38.72	77.63
MAXIMUM	56.00	62.00	40.00	53.00	64.00
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	1.00	1.00	1.00	1.00	1.00
3RD QUARTILE	2.00	2.00	2.00	2.00	2.00
90TH PERCENTILE	4.00	4.00	3.00	4.00	4.00
95TH PERCENTILE	6.00	6.00	6.00	7.00	7.00
99TH PERCENTILE	14.00	17.00	12.00	19.00	15.25
MODE	1.00	1.00	0.00	1.00	0.00
% OF HOURS OVER CRITERIA	0.00	0.00	0.00	0.00	0.00

A 1.7

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

POLLUTANT OZONE

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8208.00	8417.00	8441.00	8530.00	8409.00
MEAN	24.77	22.68	21.46	22.73	27.61
STANDARD DEVIATION	14.60	14.03	14.07	15.26	15.27
COEFFICIENT OF VARIATION	58.94	61.86	65.55	67.14	55.30
VARIANCE	213.11	196.89	197.87	232.94	233.12
SKENNESS	1.14	0.80	0.78	1.21	0.53
KURTOSIS	2.70	0.96	1.09	2.43	0.47
MAXIMUM	100.00	93.00	106.00	106.00	96.00
5TH PERCENTILE	4.00	3.00	1.00	2.00	3.00
10TH PERCENTILE	7.00	5.00	3.00	5.00	8.00
1ST QUARTILE	15.00	12.00	11.00	13.00	17.00
MEDIAN	24.00	21.00	20.00	21.00	27.00
3RD QUARTILE	32.00	31.00	30.00	29.00	37.00
90TH PERCENTILE	42.00	41.00	38.00	42.00	47.00
95TH PERCENTILE	50.00	48.00	47.00	52.00	54.00
99TH PERCENTILE	77.00	65.00	64.00	73.00	71.00
MODE	24.00	23.00	21.00	20.00	27.00
# OF HOURS OVER CRITERIA	64.00	13.00	13.00	47.00	19.00

A 1.8

ONTARIO MINISTRY OF THE ENVIRONMENT
SOUTHEASTERN REGION AIR QUALITY SECTION
SUMMARY STATISTICS FOR CORNWALL 1980-1984

STATION=MEMORIAL PARK

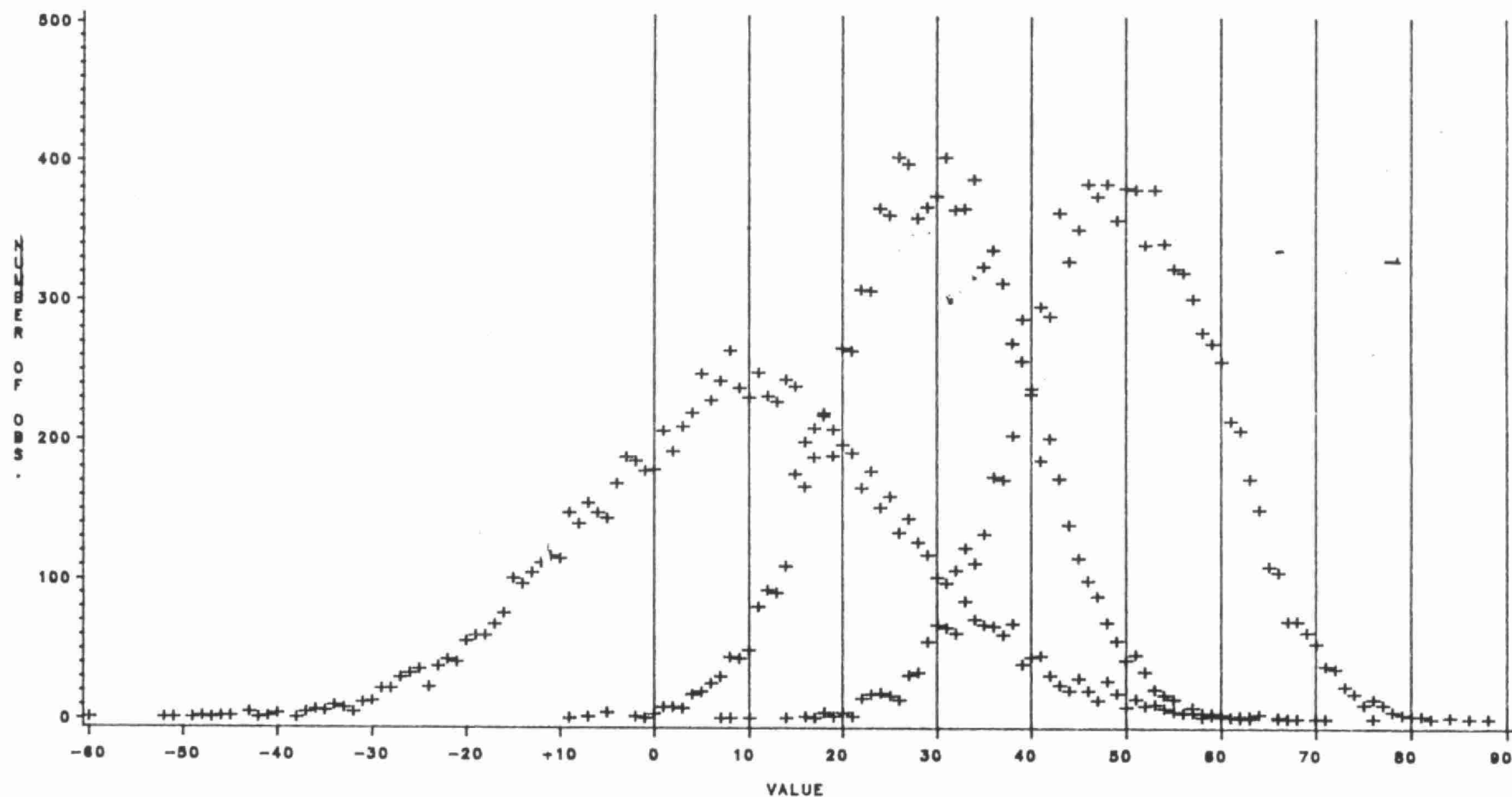
POLLUTANT SOILING INDEX

	YEAR				
	1980	1981	1982	1983	1984
	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS	YEARLY SUMMARY STATISTICS
	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE	INCLUSIVE
COMPUTED STATISTICS					
NUMBER OF OBS USED	8499.00	8390.00	8294.00	8441.00	8432.00
MEAN	0.18	0.10	0.16	0.18	0.16
STANDARD DEVIATION	0.22	0.18	0.24	0.21	0.21
COEFFICIENT OF VARIATION	119.88	185.71	146.32	114.35	127.11
VARIANCE	0.05	0.03	0.06	0.04	0.04
SKEWNESS	2.66	3.70	2.65	2.10	2.48
KURTOSIS	14.64	22.53	11.19	8.76	10.77
MAXIMUM	3.00	2.30	2.40	2.30	1.90
5TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
10TH PERCENTILE	0.00	0.00	0.00	0.00	0.00
1ST QUARTILE	0.00	0.00	0.00	0.00	0.00
MEDIAN	0.20	0.00	0.10	0.20	0.10
3RD QUARTILE	0.30	0.20	0.20	0.30	0.20
90TH PERCENTILE	0.40	0.30	0.40	0.40	0.40
95TH PERCENTILE	0.60	0.40	0.60	0.60	0.50
99TH PERCENTILE	1.00	0.80	1.10	0.90	0.90
MODE	0.00	0.00	0.00	0.00	0.00
# OF HOURS OVER CRITERIA	72.00	50.00	83.00	49.00	63.00

A 1.9

SAMPLE OF 10,000 OBSERVATIONS FROM A NORMAL DISTRIBUTION

WITH MEAN=50 AND STANDARD DEVIATION=10
 WITH MEAN=30 AND STANDARD DEVIATION=10
 WITH MEAN=10 AND STANDARD DEVIATION=17

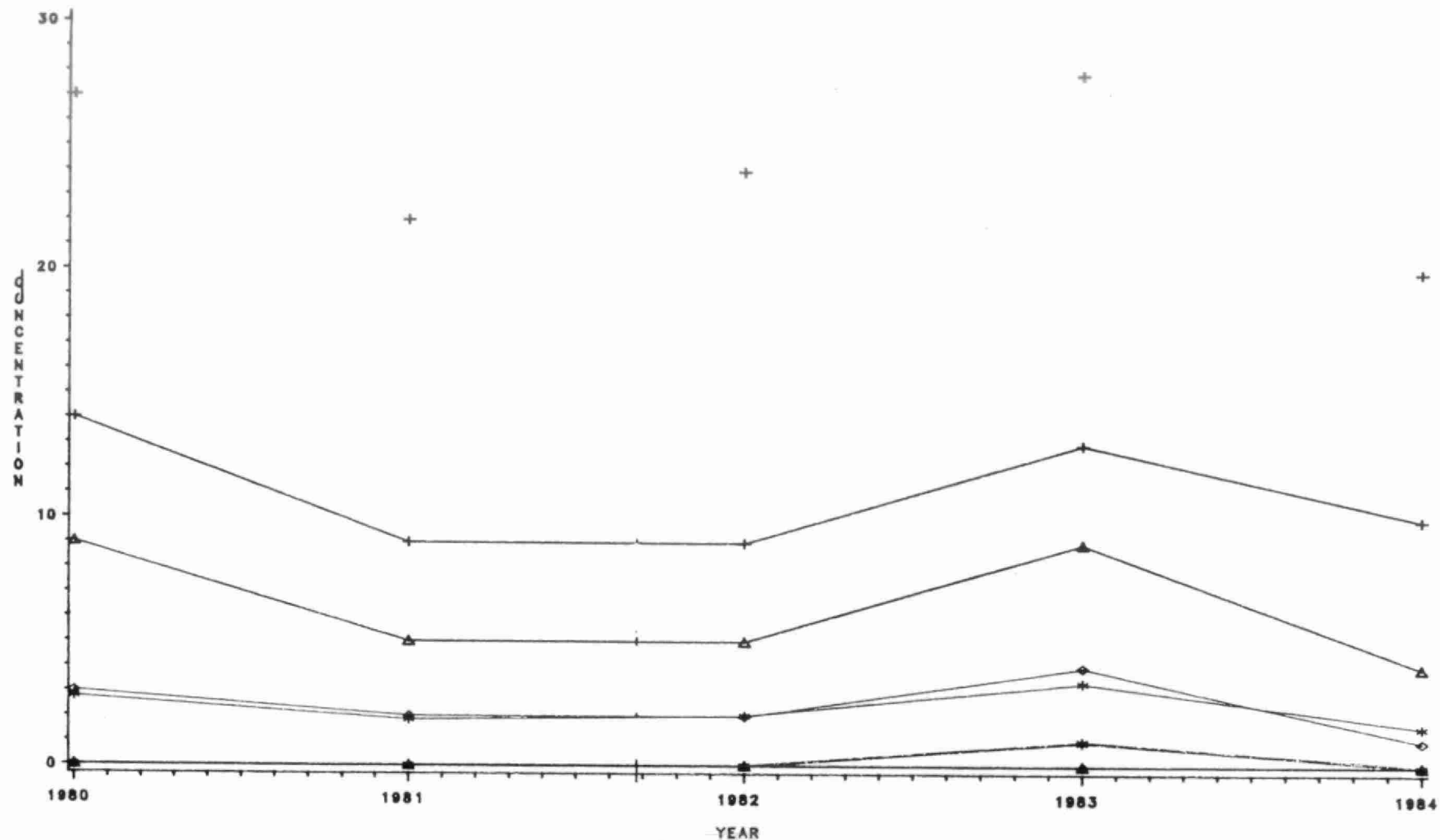


DIST + + + 1 + + + 2 + + + 3

68 % OF DATA LIES WITHIN PLUS OR MINUS 1 STD DEVIATION
 OF THE MEAN. 95% OF DATA LIES WITHIN PLUS OR MINUS 2
 STD DEVIATIONS OF THE MEAN. 99.7% OF THE DATA LIES
 WITHIN PLUS OR MINUS 3 STD DEVIATIONS OF THE MEAN.
 REFERENCE DRAWN FROM SAS USERS GUIDE: BASICS VERSION 8
 SAS INSTITUTE INC. BOX 8000 CARY, NC 27511-8000. PG 743

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-MEMORIAL PARK POLLUT-HYDROGEN SULPHIDE

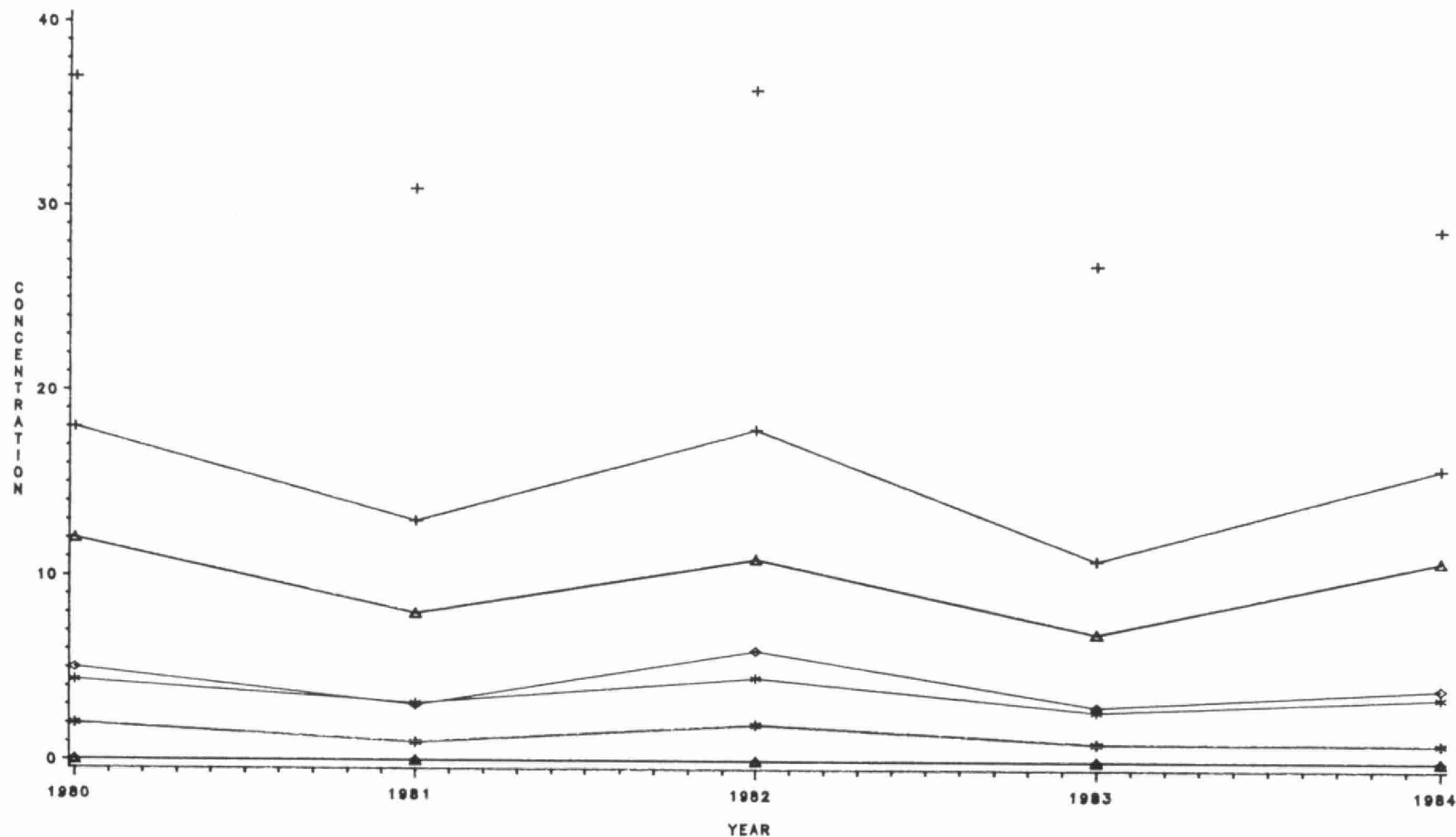


VARIATE + + + MEAN △ △ △ 10TH PERCENTILE ◇ ◇ ◇ 1ST QUARTILE * * * MEDIAN
 ◇ ◇ ◇ 3RD QUANTILE △ △ △ 90TH PERCENTILE + + + 95TH PERCENTILE + + + 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-ST.FRANCIS SCHOOL POLLUT-HYDROGEN SULPHIDE



VARIATE
+ + + + MEAN
◇ ◇ ◇ 3RD QUANTILE

△ △ △ 10TH PERCENTILE
△ △ △ 90TH PERCENTILE

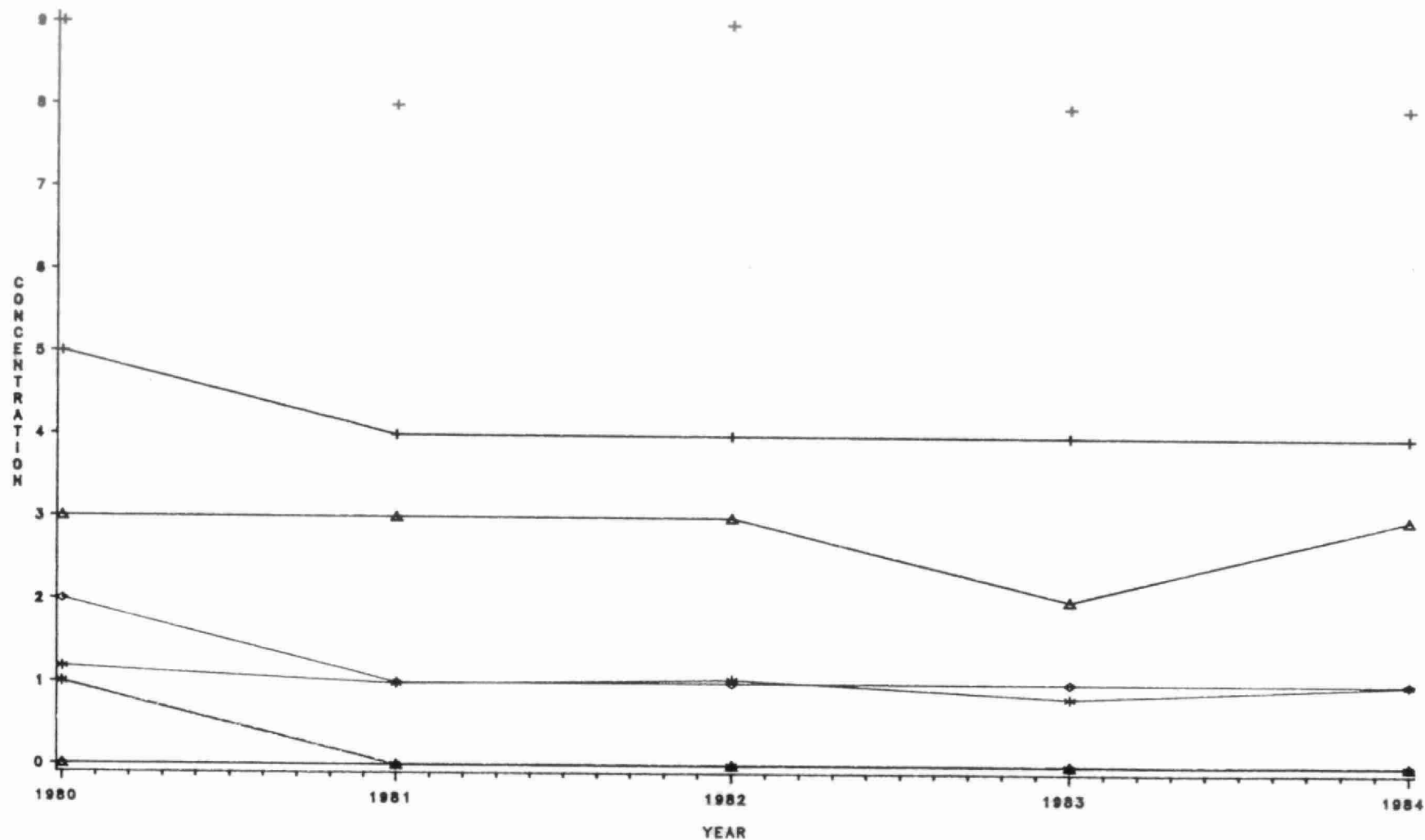
◇ ◇ ◇ 1ST QUANTILE
+ + + 95TH PERCENTILE

+ + + MEDIAN
+ + + 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-MEMORIAL PARK POLLUT-SULPHUR DIOXIDE



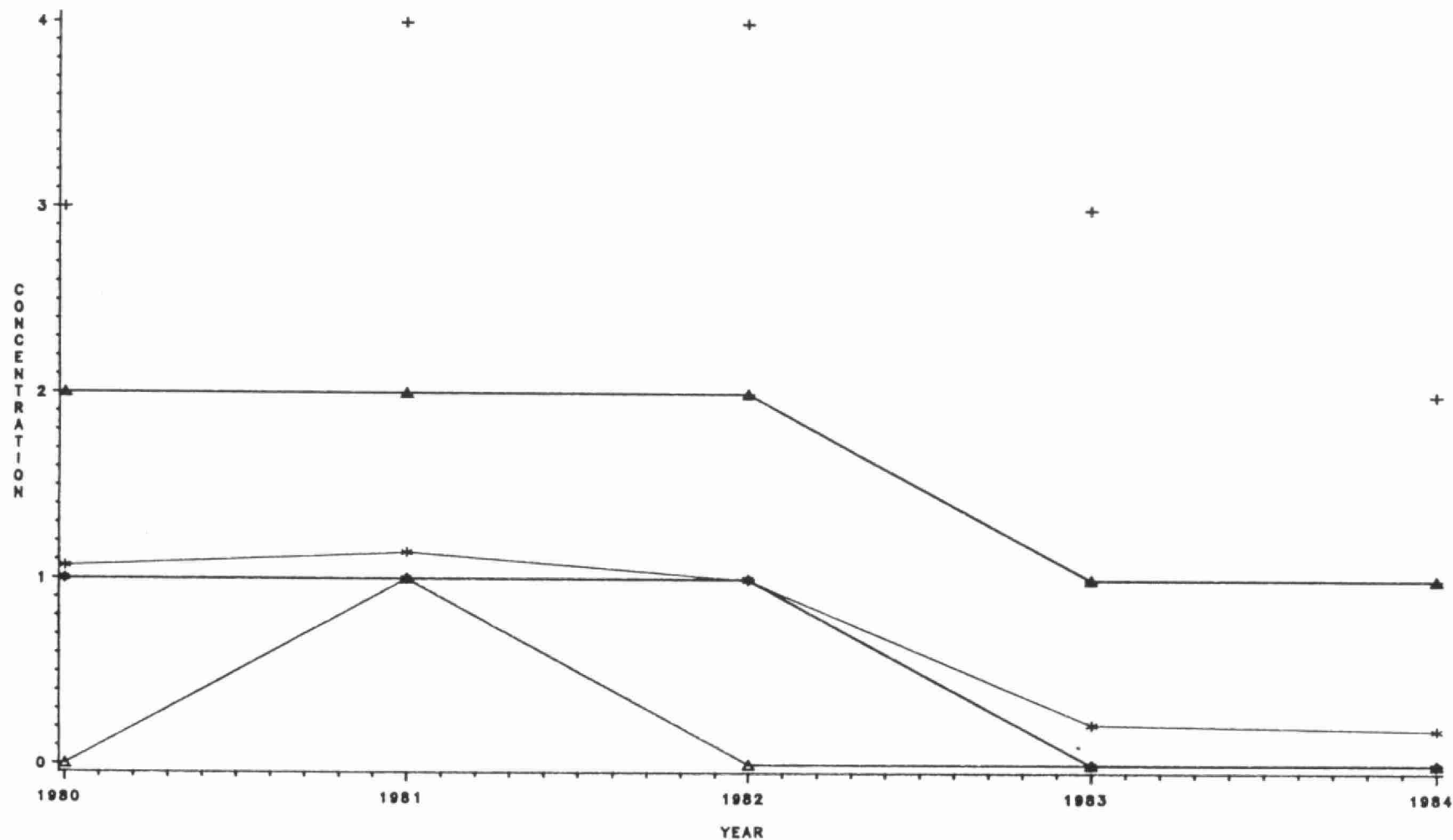
VARIATE *-*-* MEAN ▲-▲-▲ 10TH PERCENTILE ◇-◇-◇ 1ST QUARTILE *-*-* MEDIAN
 ◇-◇-◇ 3RD QUARTILE ▲-▲-▲ 90TH PERCENTILE +-+-+ 95TH PERCENTILE +-+-+ 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

F 1.3

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-MEMORIAL PARK POLLUT-CARBON MONOXIDE



VARIATE *-*-* MEAN
 ♦-♦-♦ 3RD QUANTILE

△-△-△ 10TH PERCENTILE
△-△-△ 90TH PERCENTILE

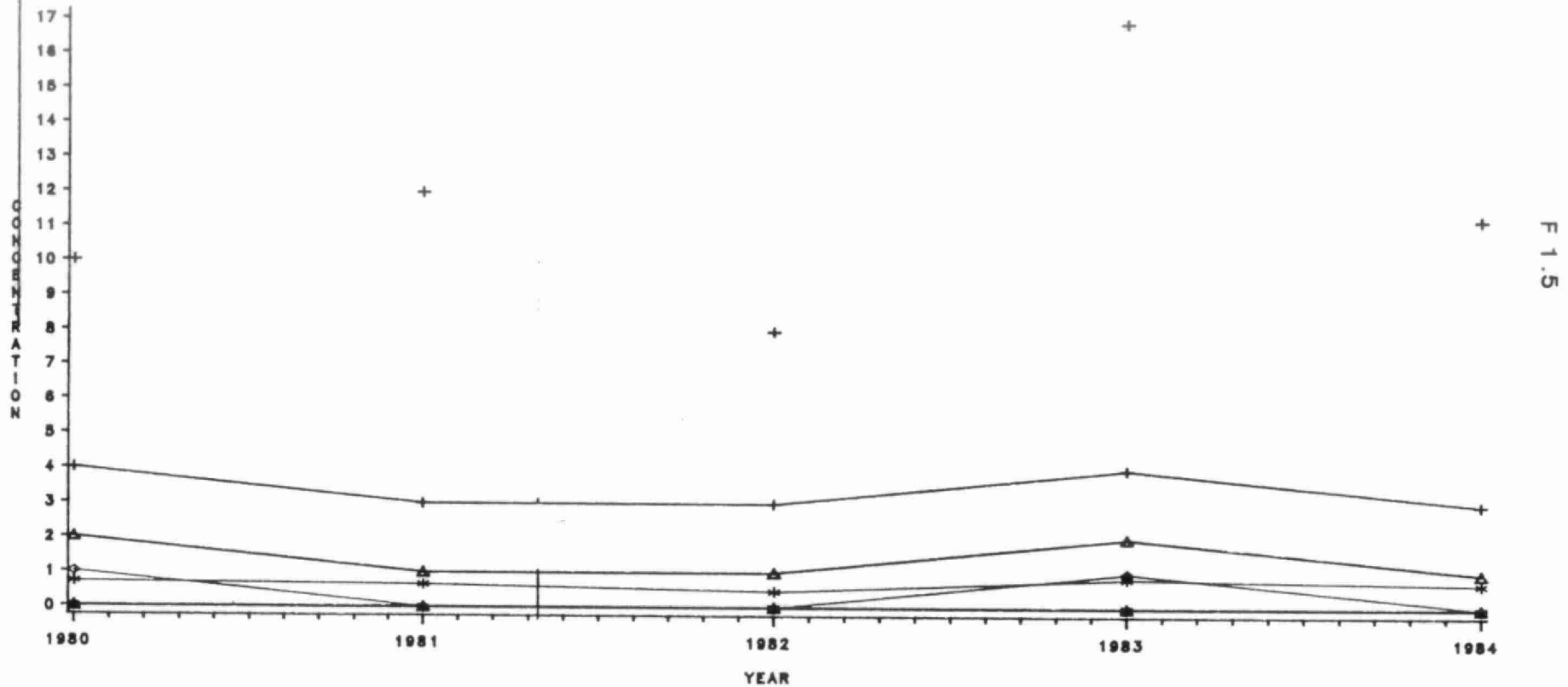
◇-◇-◇ 1ST QUANTILE
+--+ 95TH PERCENTILE

--* MEDIAN
+++ 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-MEMORIAL PARK POLLUT-NITRIC OXIDE



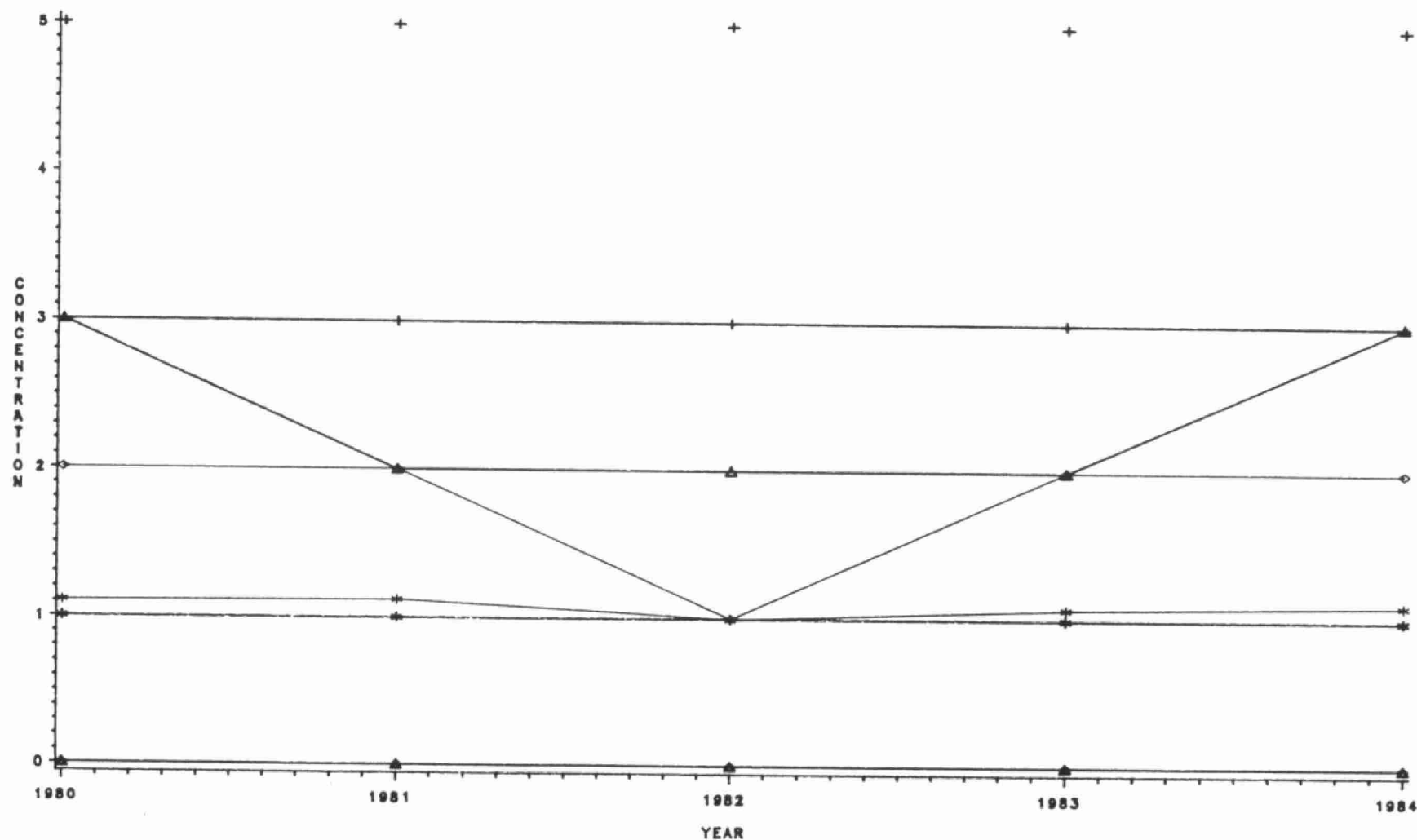
VARIATE + + + MEAN * * * 10TH PERCENTILE ◇ ◇ ◇ 1ST QUARTILE + + + MEDIAN
 ◇ ◇ ◇ 3RD QUARTILE * * * 90TH PERCENTILE + + + 95TH PERCENTILE + + + 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

F 1.5

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-MEMORIAL PARK POLLUT-NITROGEN DIOXIDE



VARIATE
*** MEAN
--- 3RD QUARTILE

--- 10TH PERCENTILE
--- 90TH PERCENTILE

--- 1ST QUARTILE
--- 95TH PERCENTILE

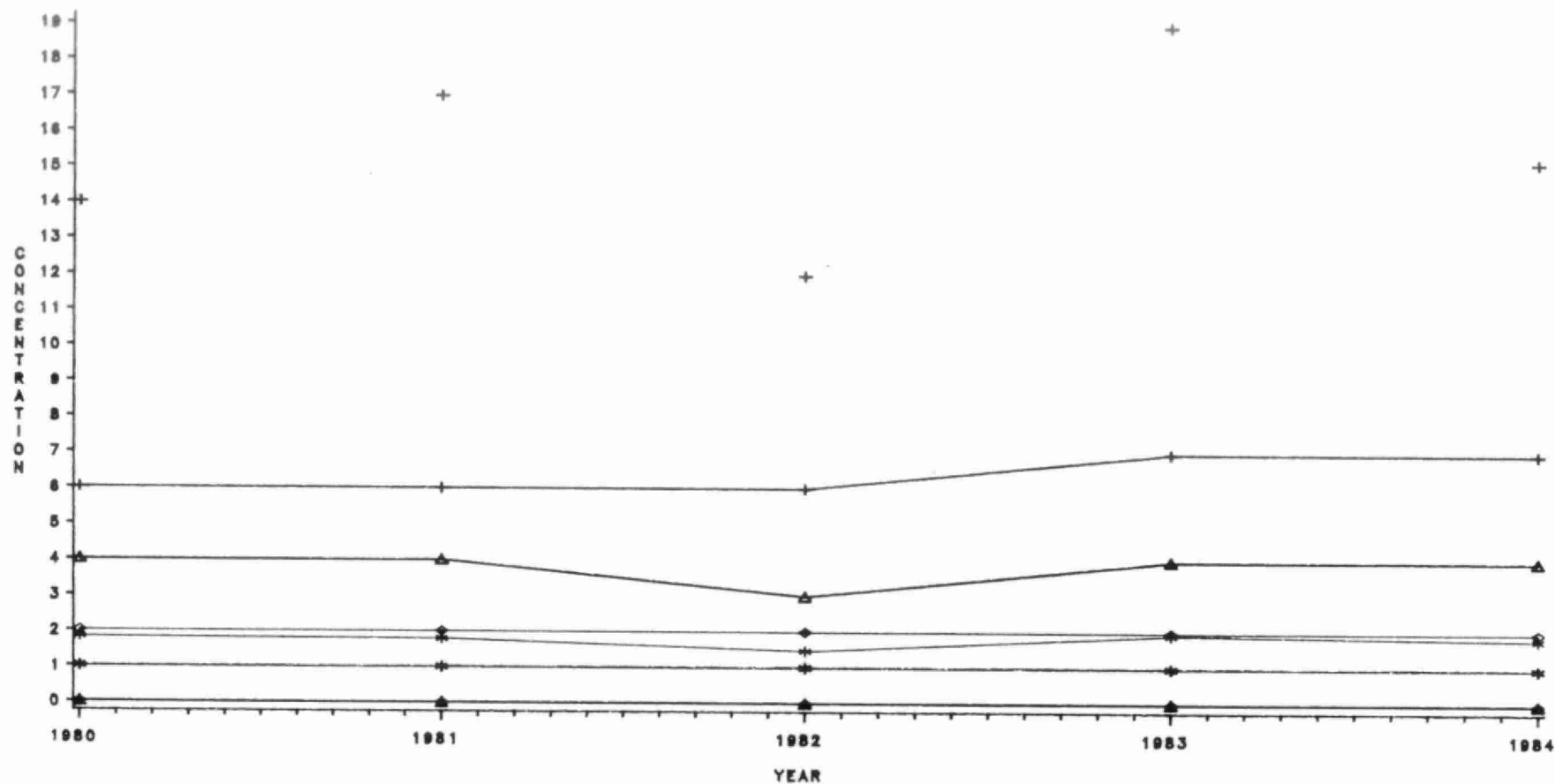
*** MEDIAN
+++ 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

F1.6

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION=MEMORIAL PARK POLLUT=TOTAL NITROGEN OXIDES

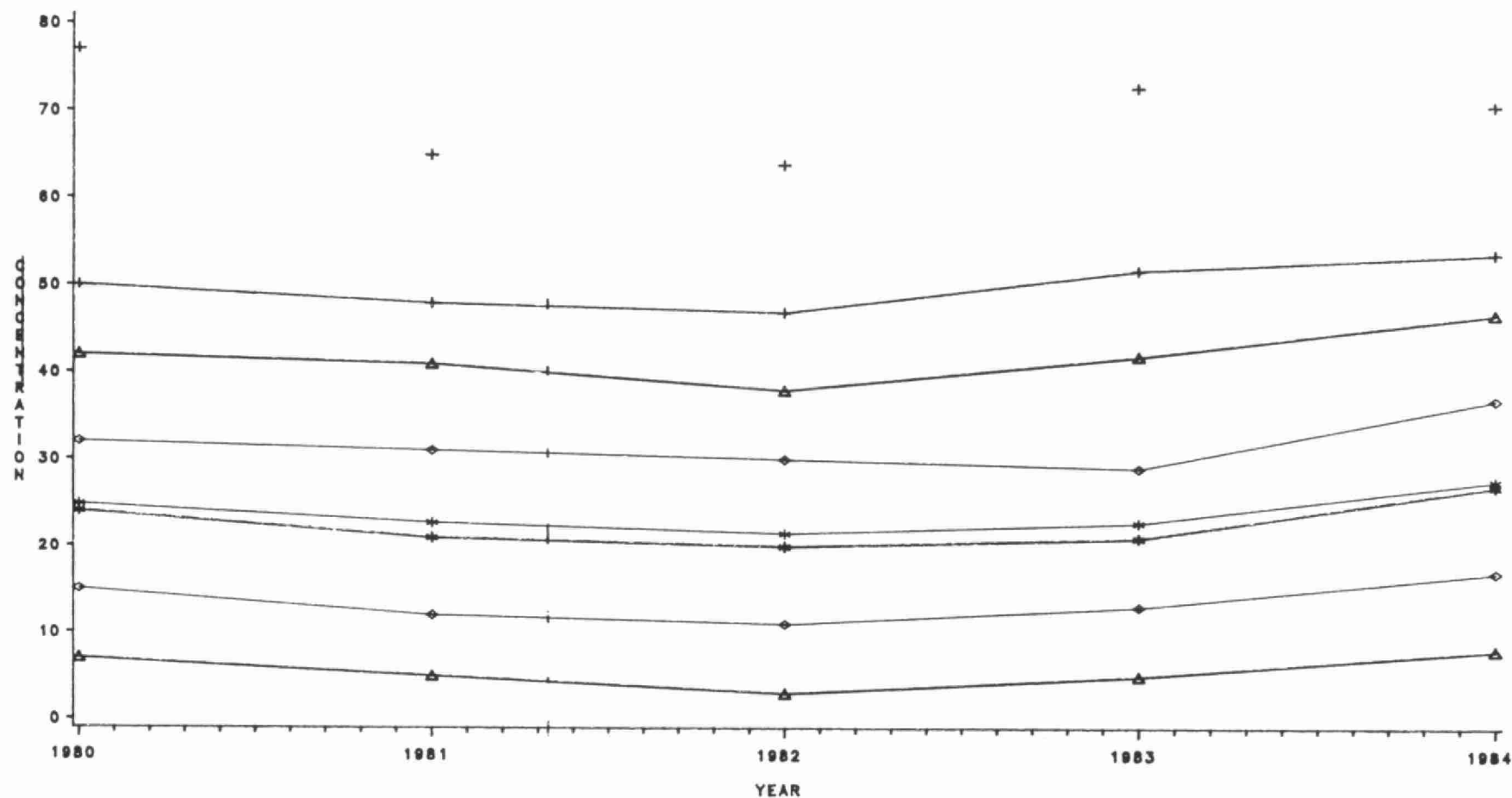


VARIATE *-*-* MEAN ▲-▲-▲ 10TH PERCENTILE ◆-◆-◆ 1ST QUARTILE *-*-* MEDIAN
 ◆-◆-◆ 3RD QUARTILE ▲-▲-▲ 90TH PERCENTILE +--+ 95TH PERCENTILE +++ 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION=MEMORIAL PARK POLLUT=OZONE



VARIATE *** MEAN
 ♦♦♦ 3RD QUARTILE

△△△ 10TH PERCENTILE
△△△ 90TH PERCENTILE

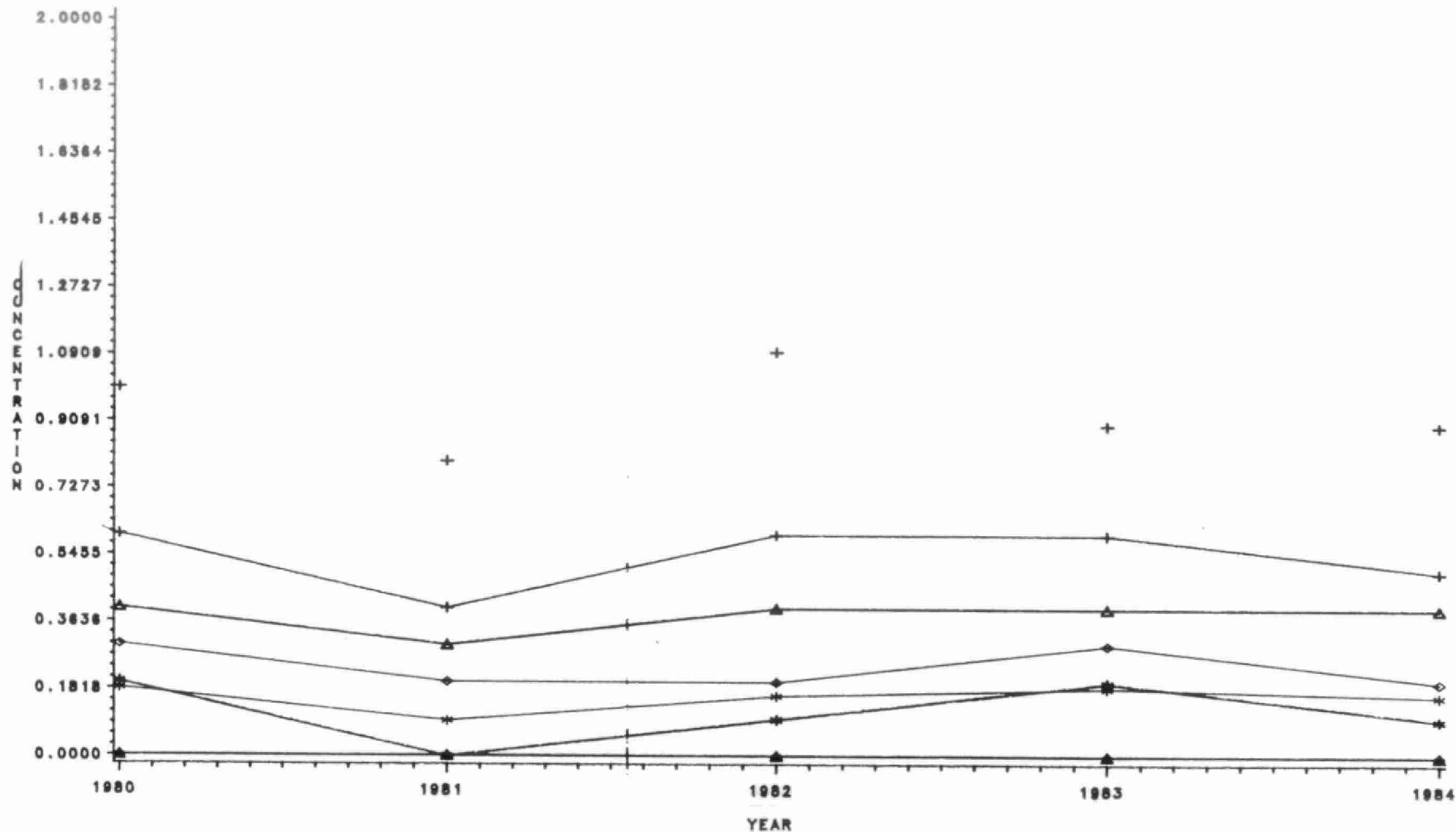
♦♦♦ 1ST QUARTILE
+++ 95TH PERCENTILE

*** MEDIAN
+++ 99TH PERCENTILE

PIECEWISE LINEAR INTERPOLATION

ONTARIO MINISTRY OF THE ENVIRONMENT

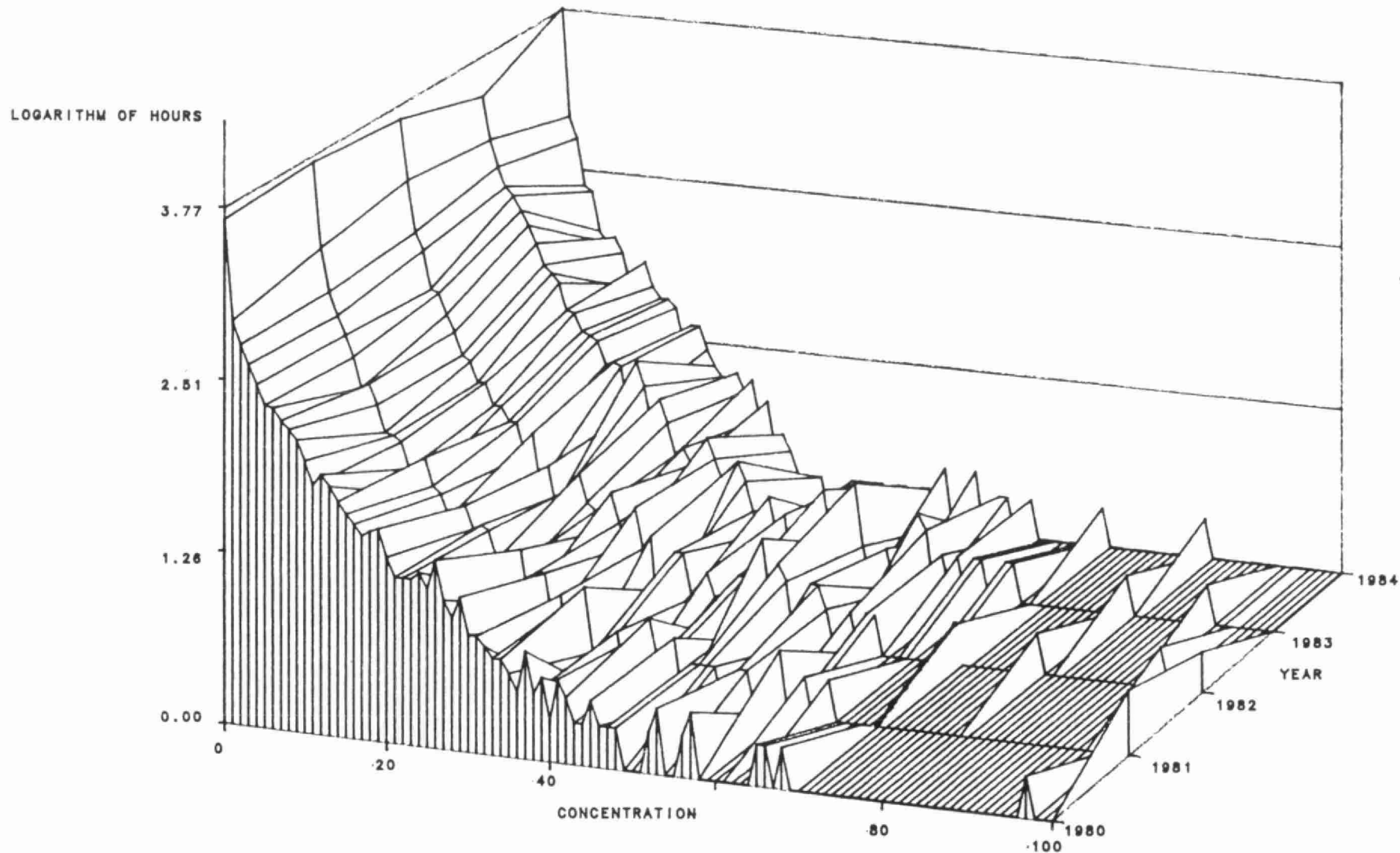
SOUTHEASTERN REGION
MULTI-YEAR PLOT OF AIR MONITORING DATA FOR CORNWALL
FOR 1980 TO 1984 INCLUSIVE
STATION-MEMORIAL PARK POLLUT-SOILING INDEX



VARIATE *-*-* MEAN *-*-* 10TH PERCENTILE *-*-* 1ST QUANTILE *-*-* MEDIAN
 --* 3RD QUANTILE *-*-* 90TH PERCENTILE *-*-* 95TH PERCENTILE *-*-* 99TH PERCENTILE

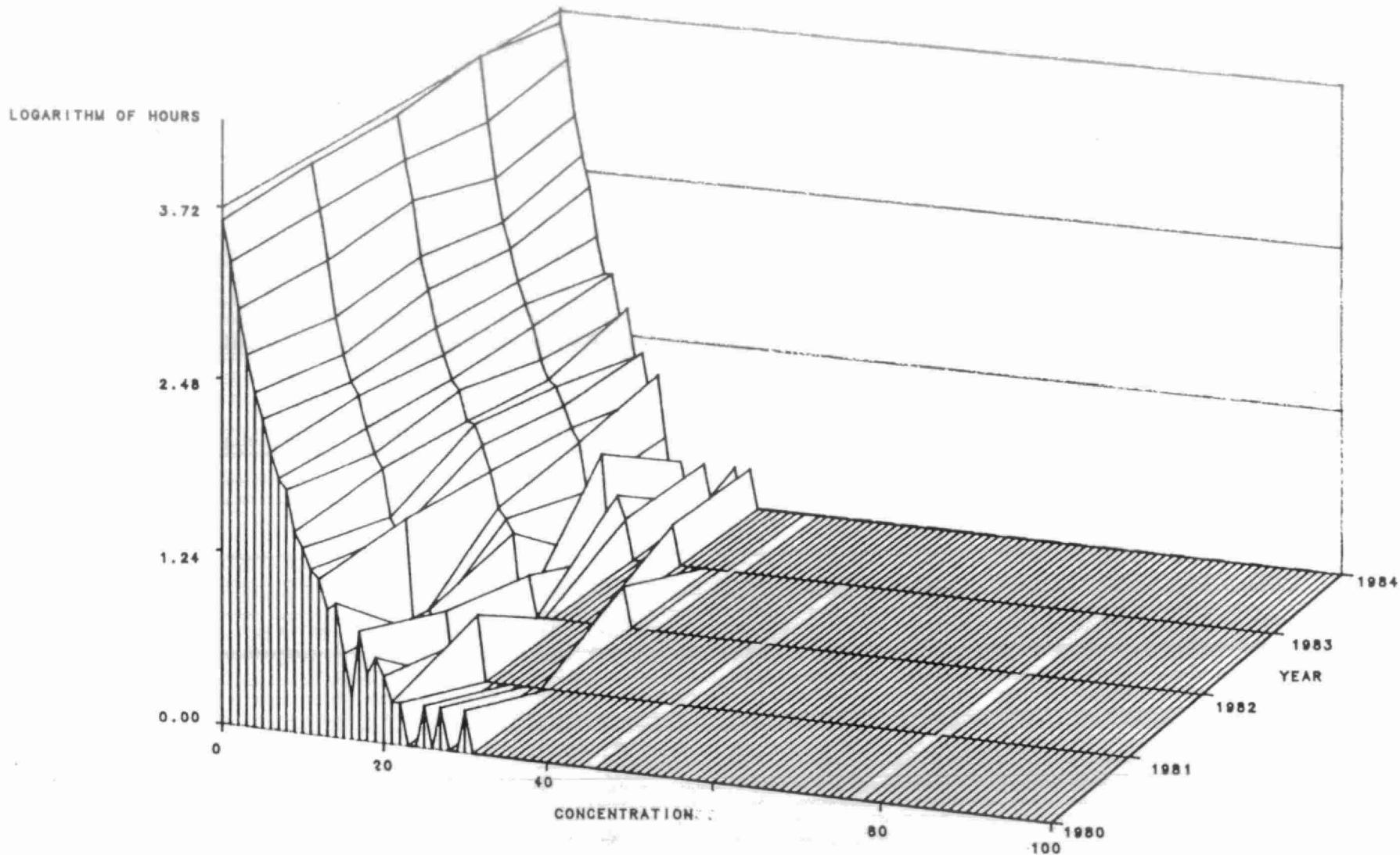
PIECEWISE LINEAR INTERPOLATION

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER=HYDROGEN SULPHIDE



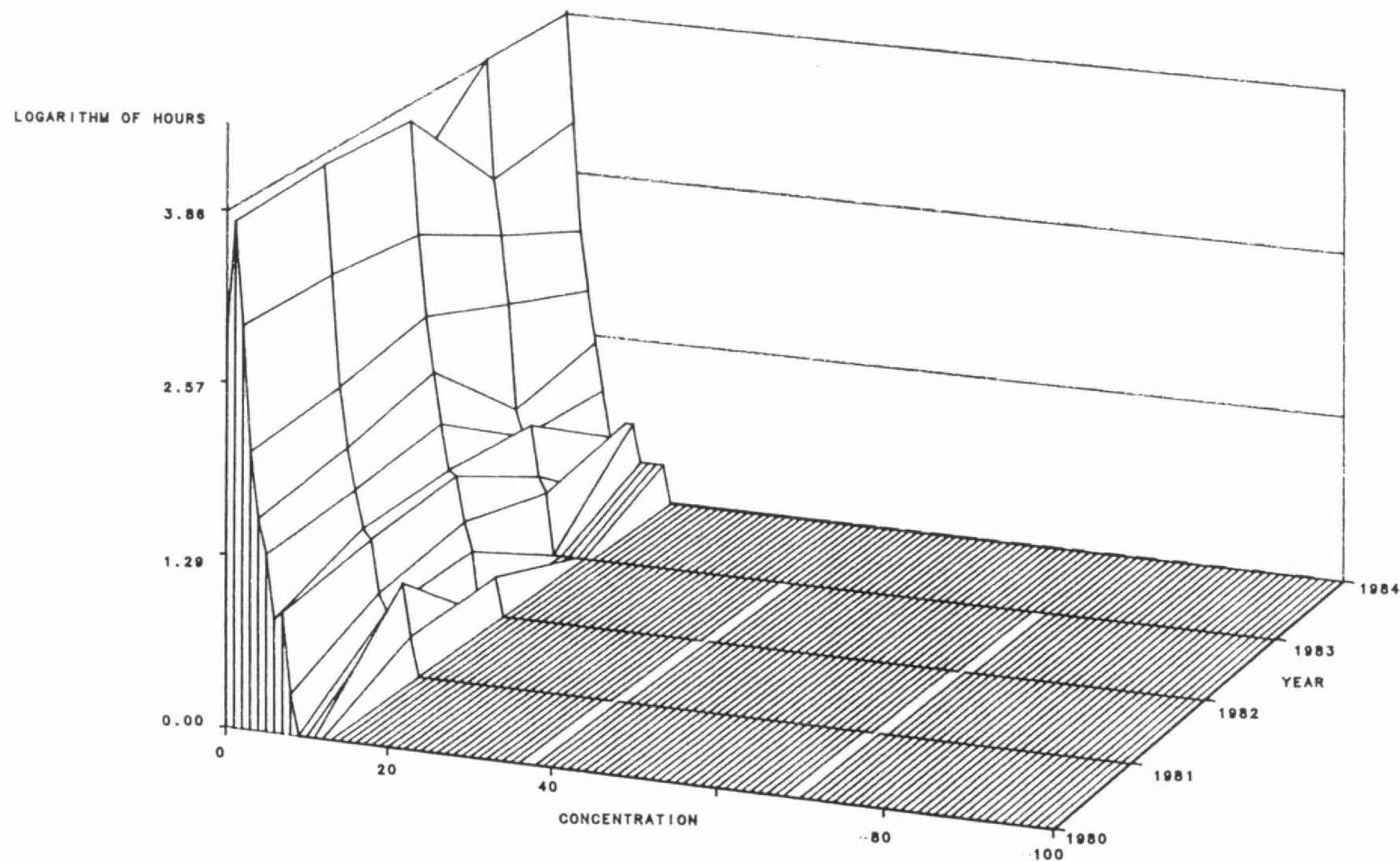
THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER=SULPHUR DIOXIDE



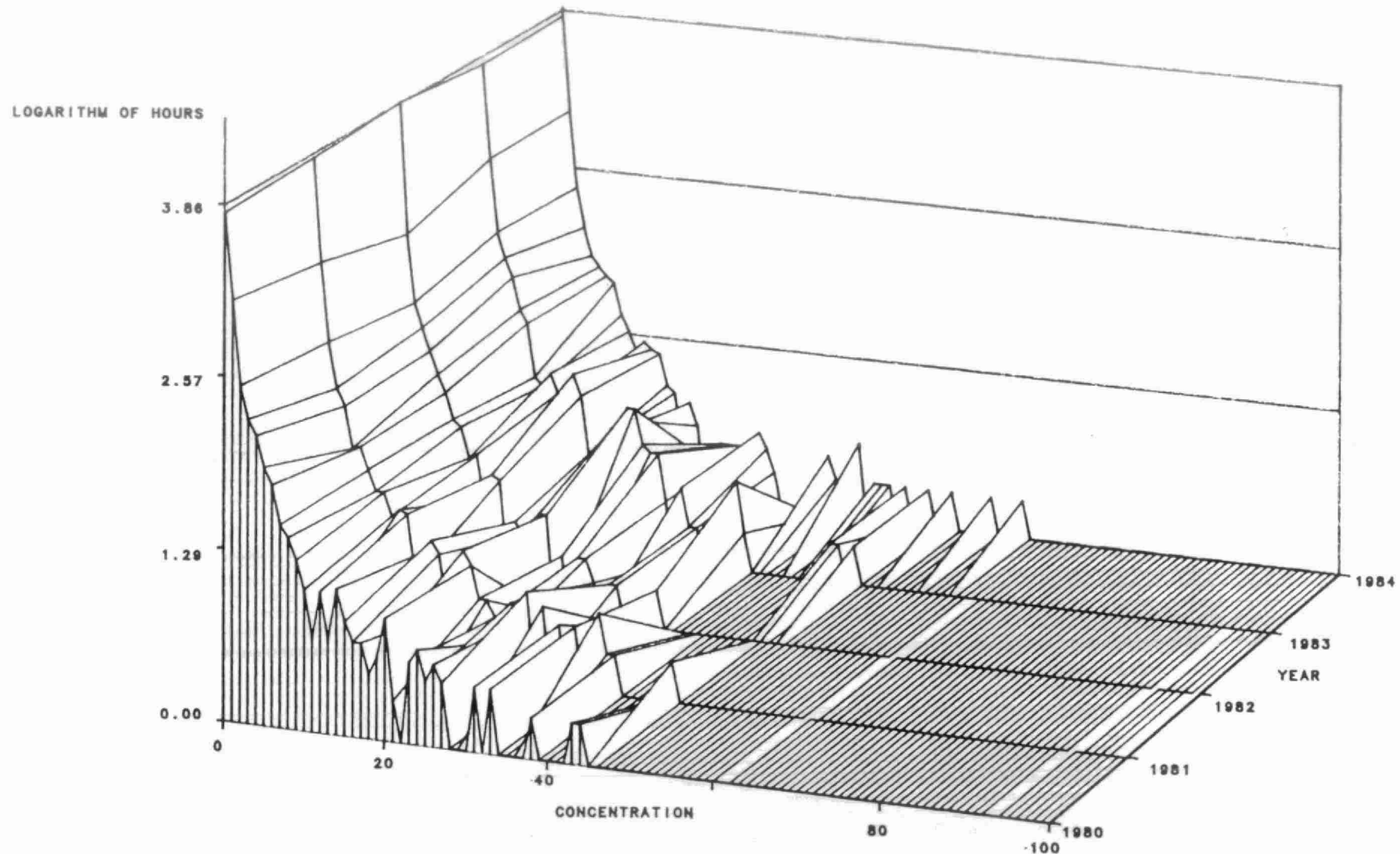
THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER=CARBON MONOXIDE



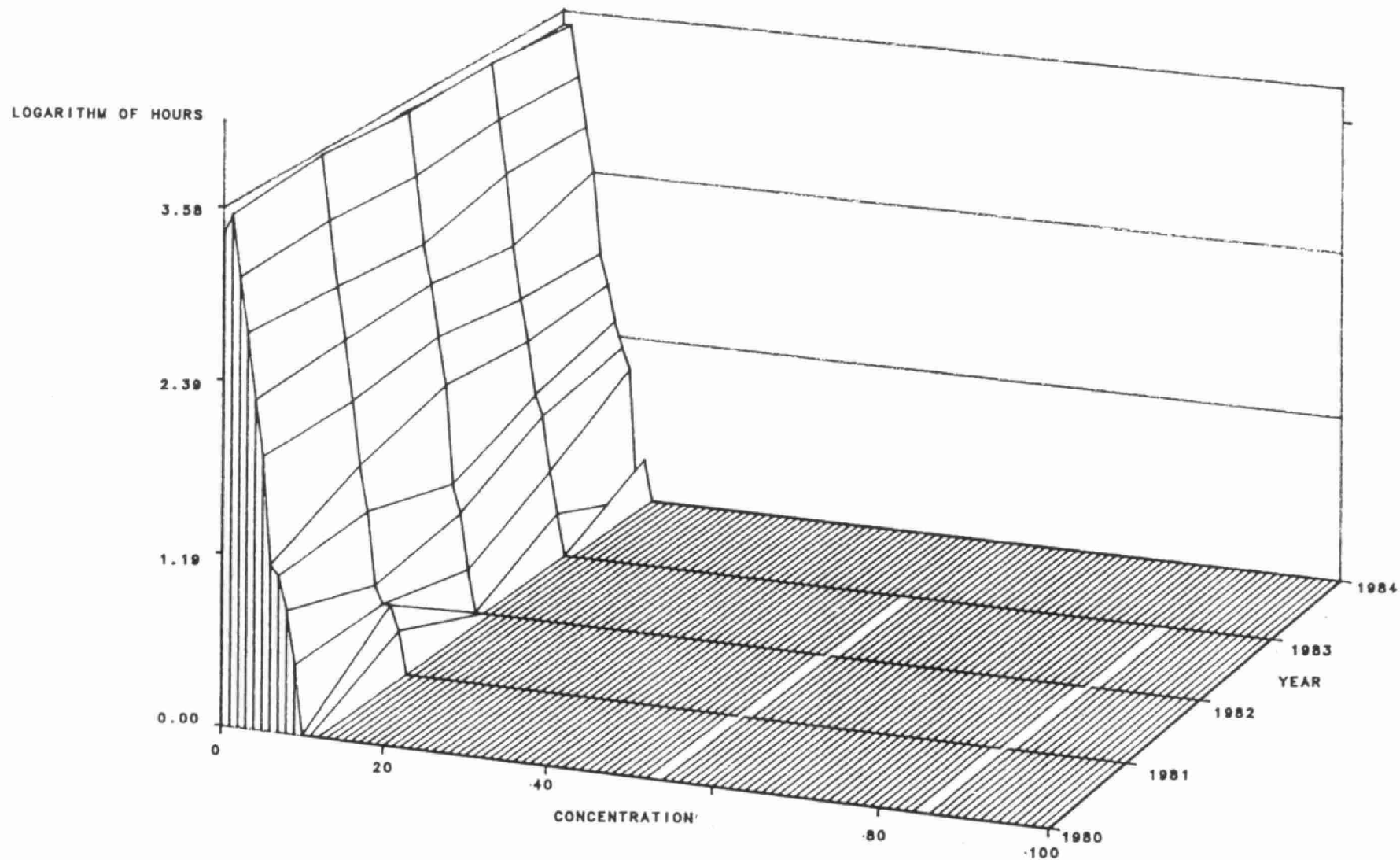
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER=NITRIC OXIDE



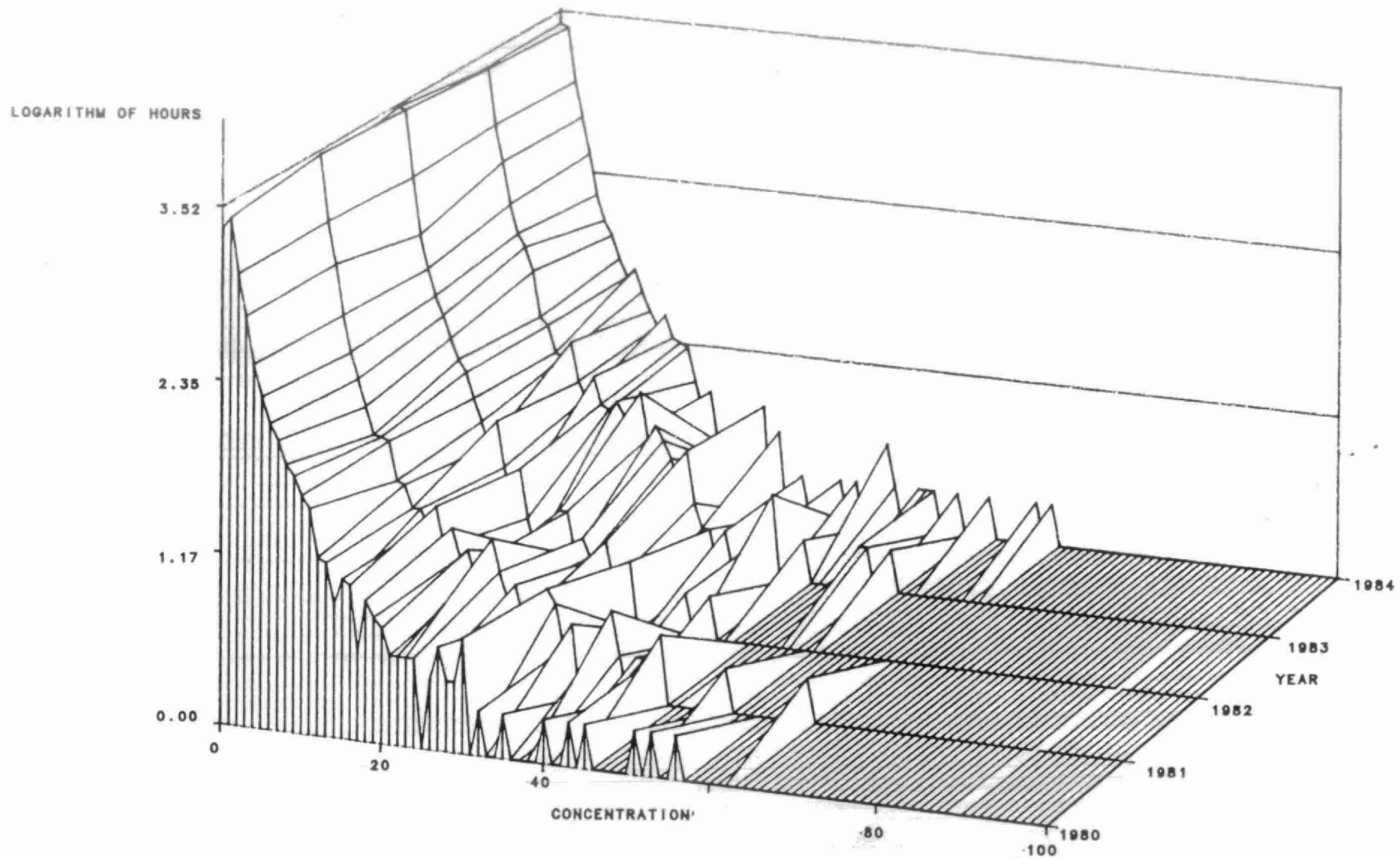
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER=NITROGEN DIOXIDE



THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER-TOTAL NITROGEN OXIDES



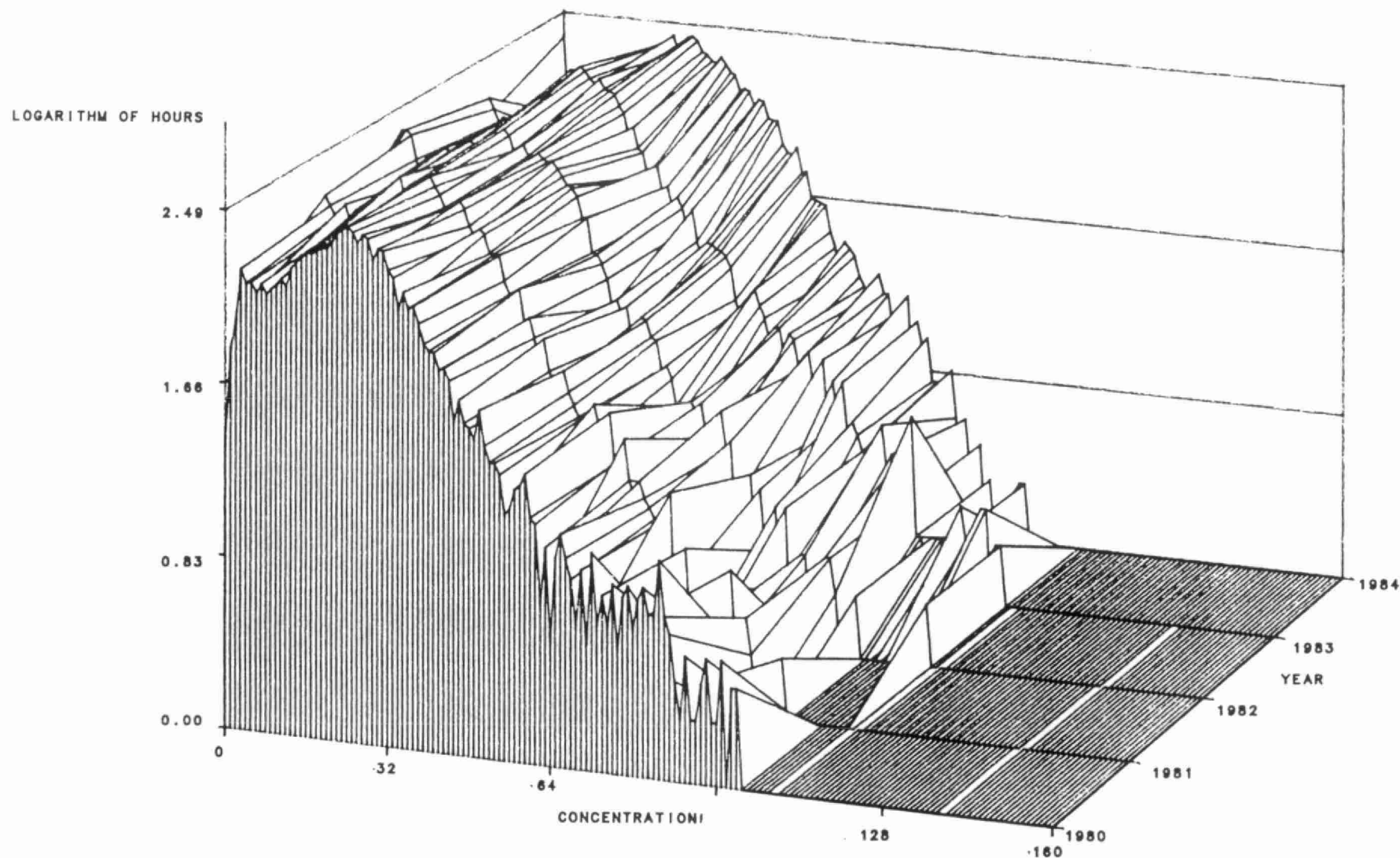
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT DATA 1980 - 1984

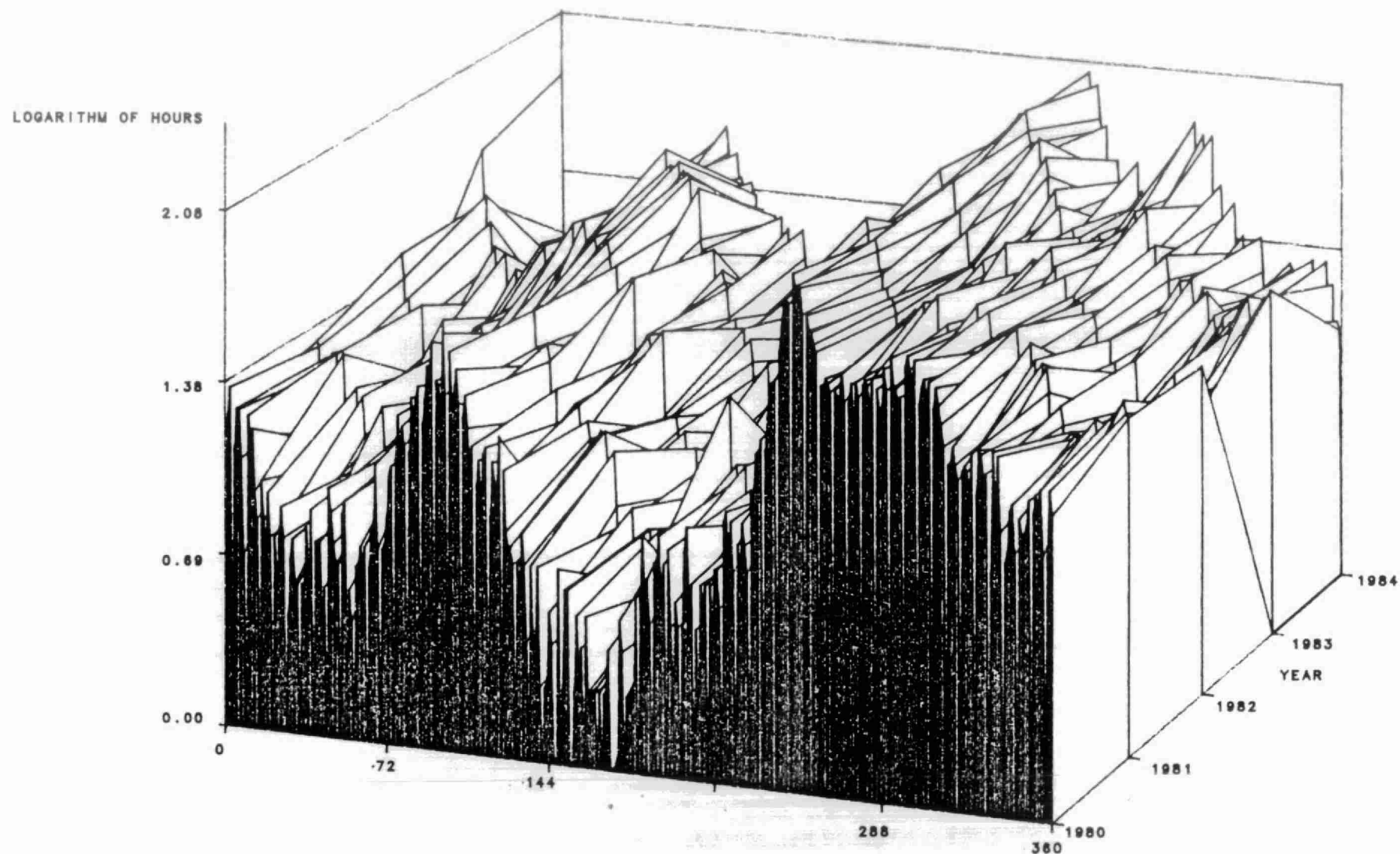
VERTICAL AXIS IS LOGARITHMIC

PARAMETER-OZONE



THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT
CORNWALL AMBIENT DATA 1980 - 1984
VERTICAL AXIS IS LOGARITHMIC
PARAMETER=WIND DIRECTION



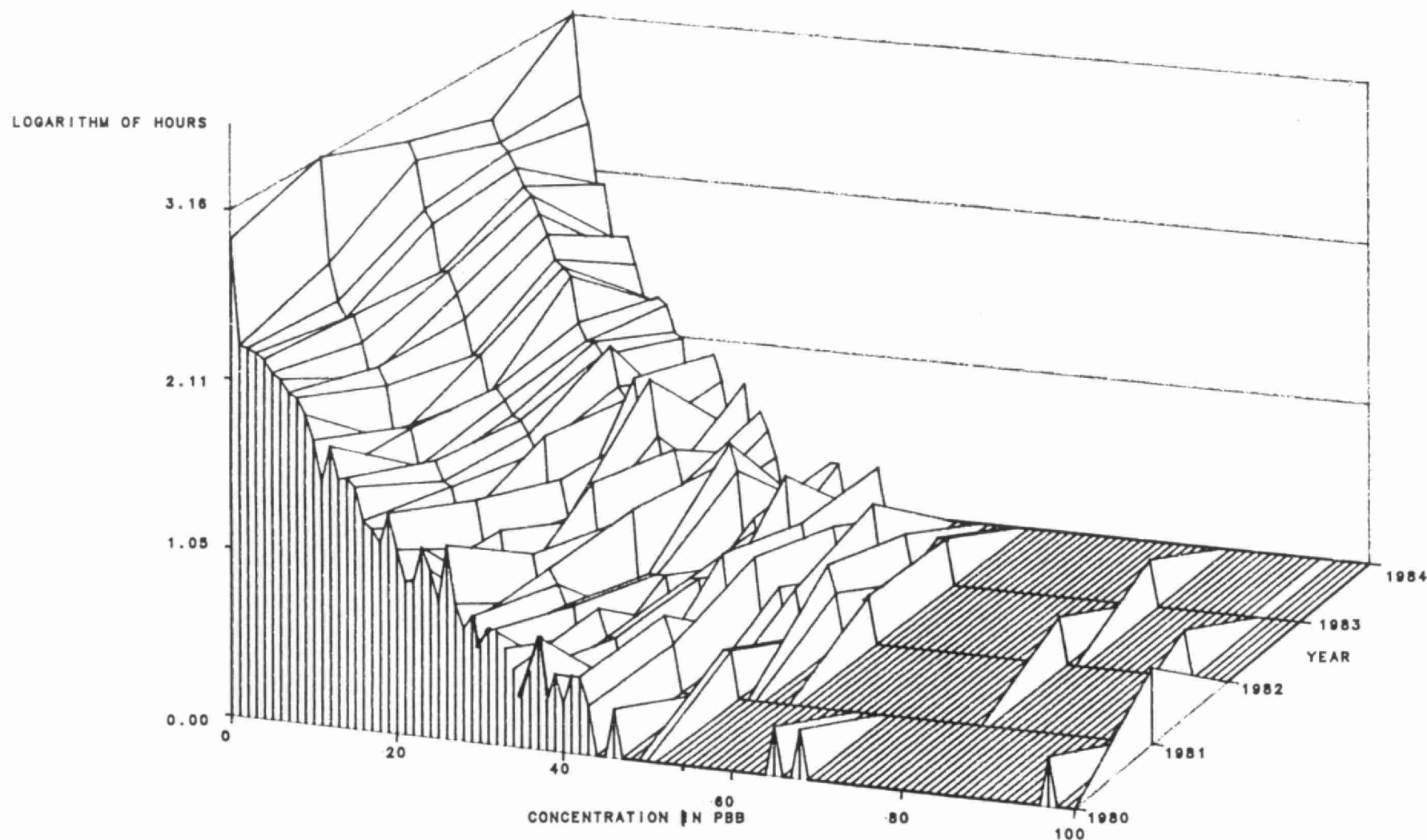
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION-MEMORIAL PARK ORIGIN-DOMTAR



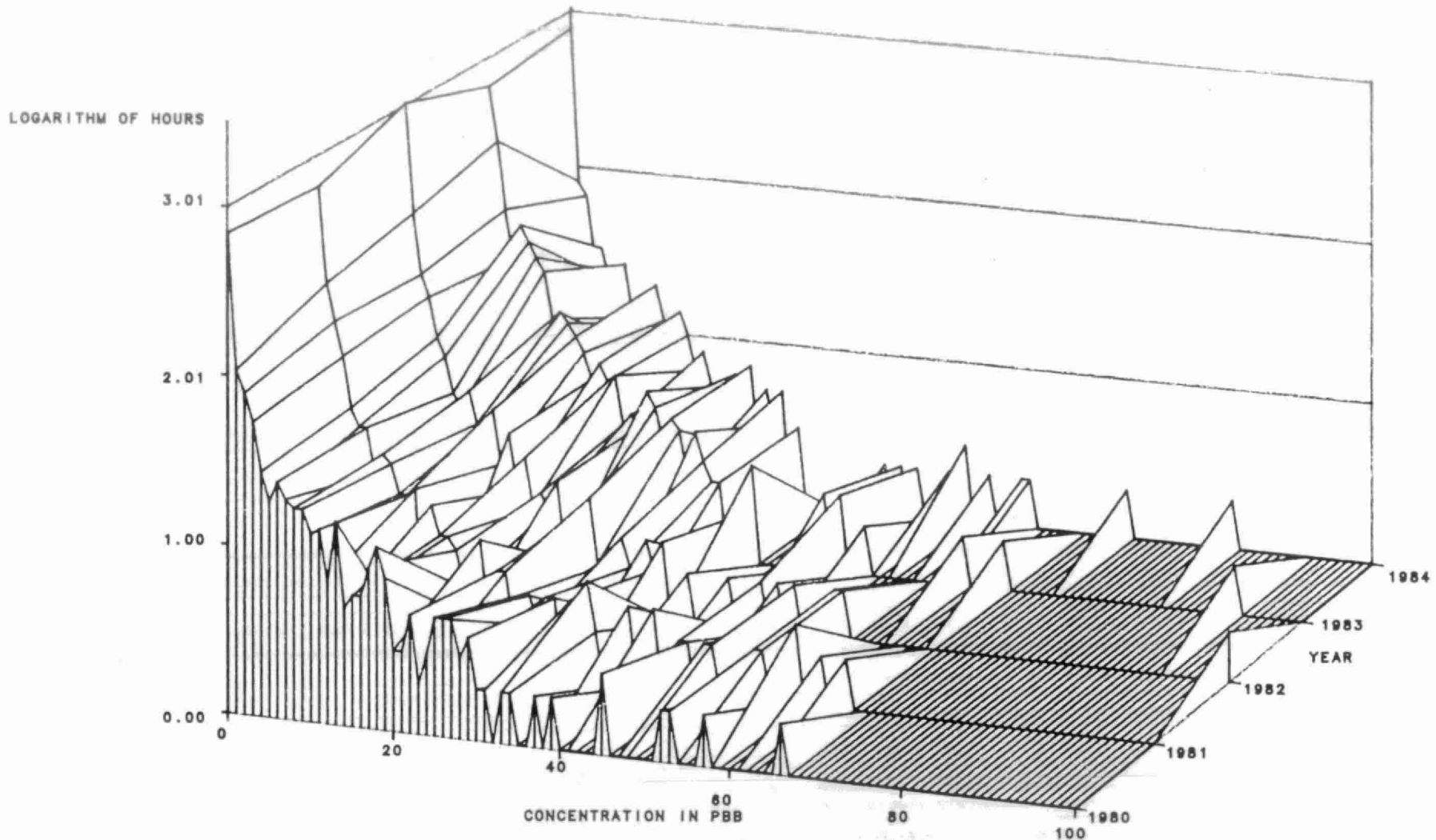
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION=MEMORIAL PARK ORIGIN=COURTAULD



THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

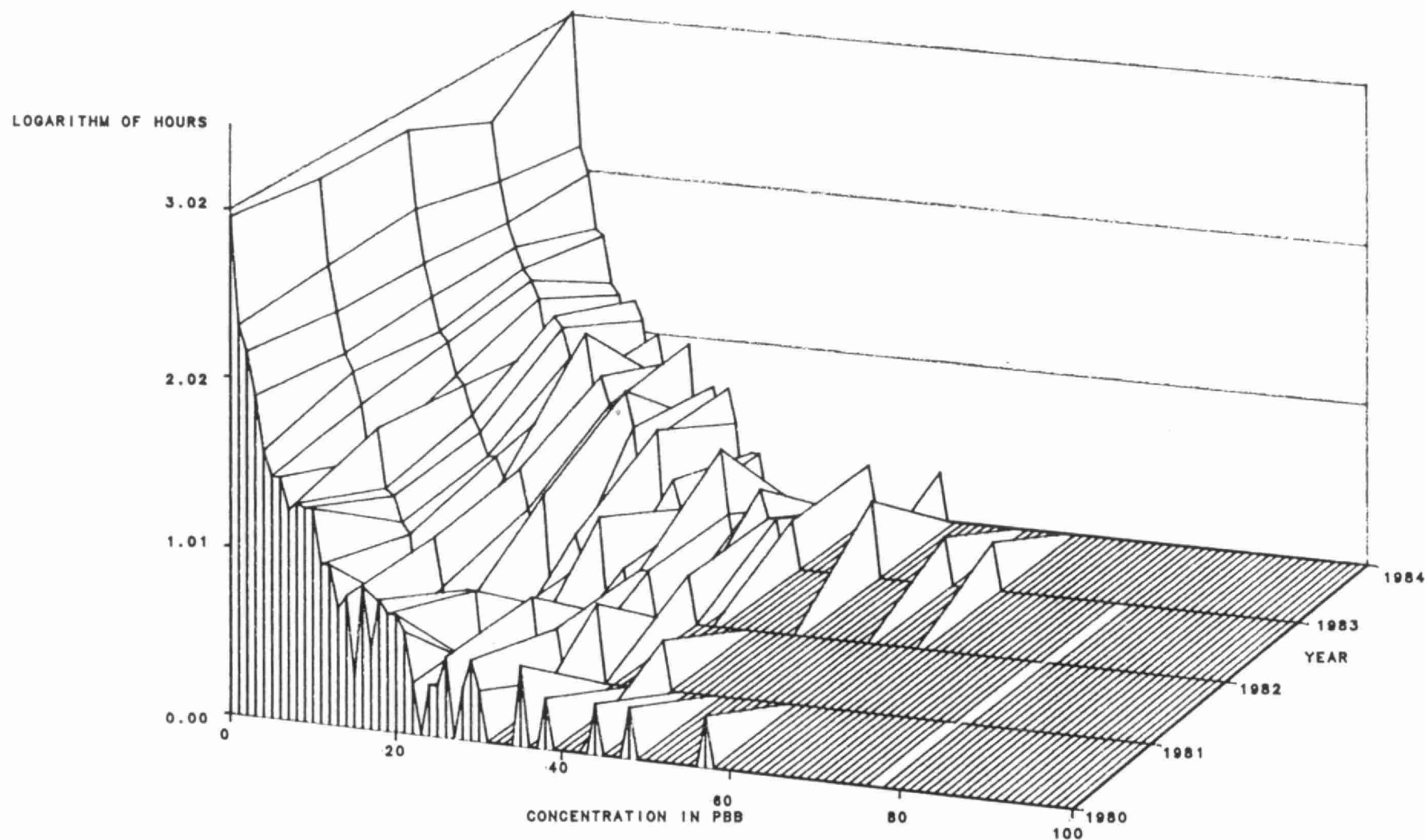
F 3.2

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION=MEMORIAL PARK ORIGIN=UNKNOWN



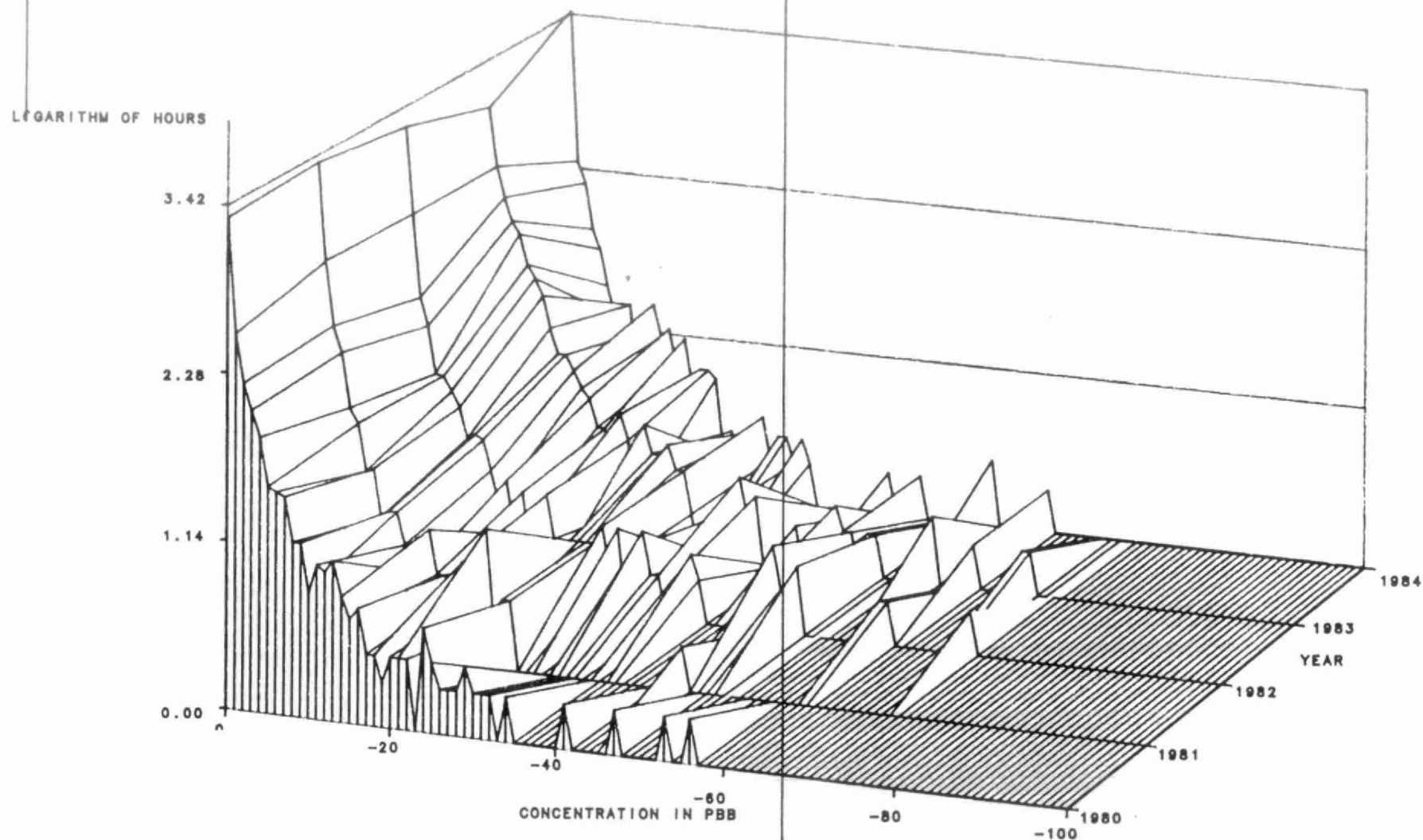
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION=MEMORIAL PARK ORIGIN=OTHER



THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

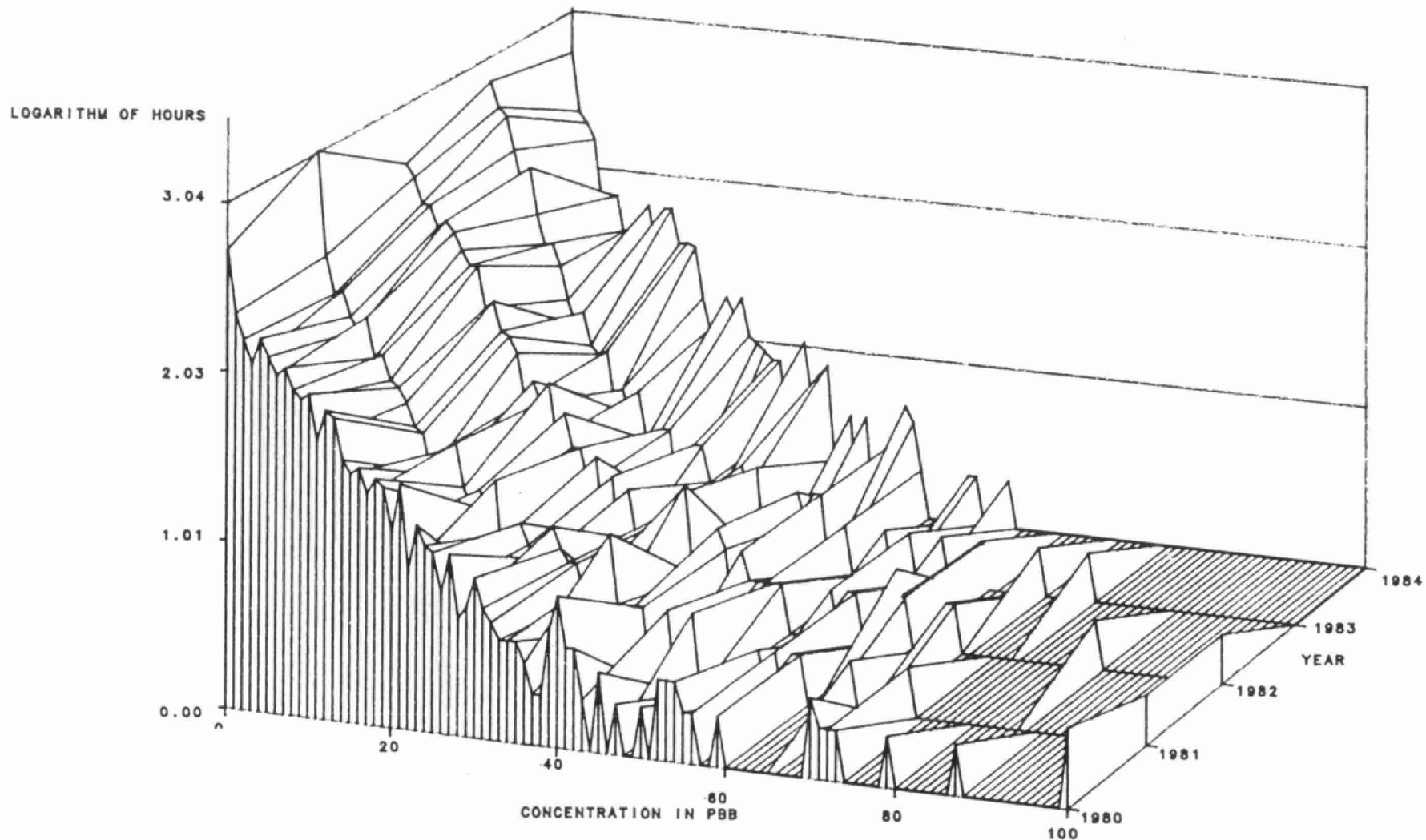
F 3.4

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION-ST. FRANCIS SCHOOL ORIGIN-DOMTAR



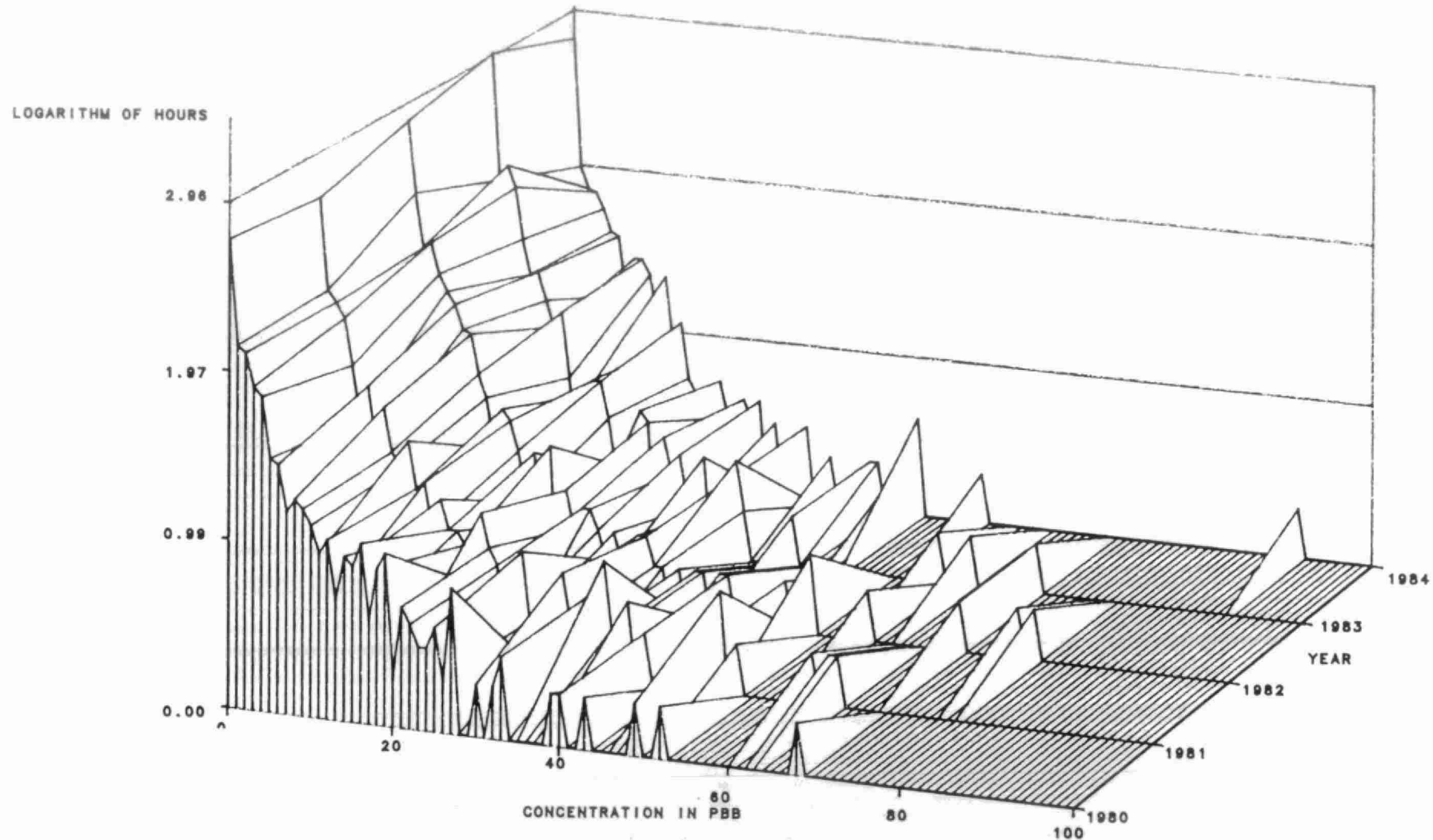
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION=ST.FRANCIS SCHOOL ORIGIN=COURTAULD



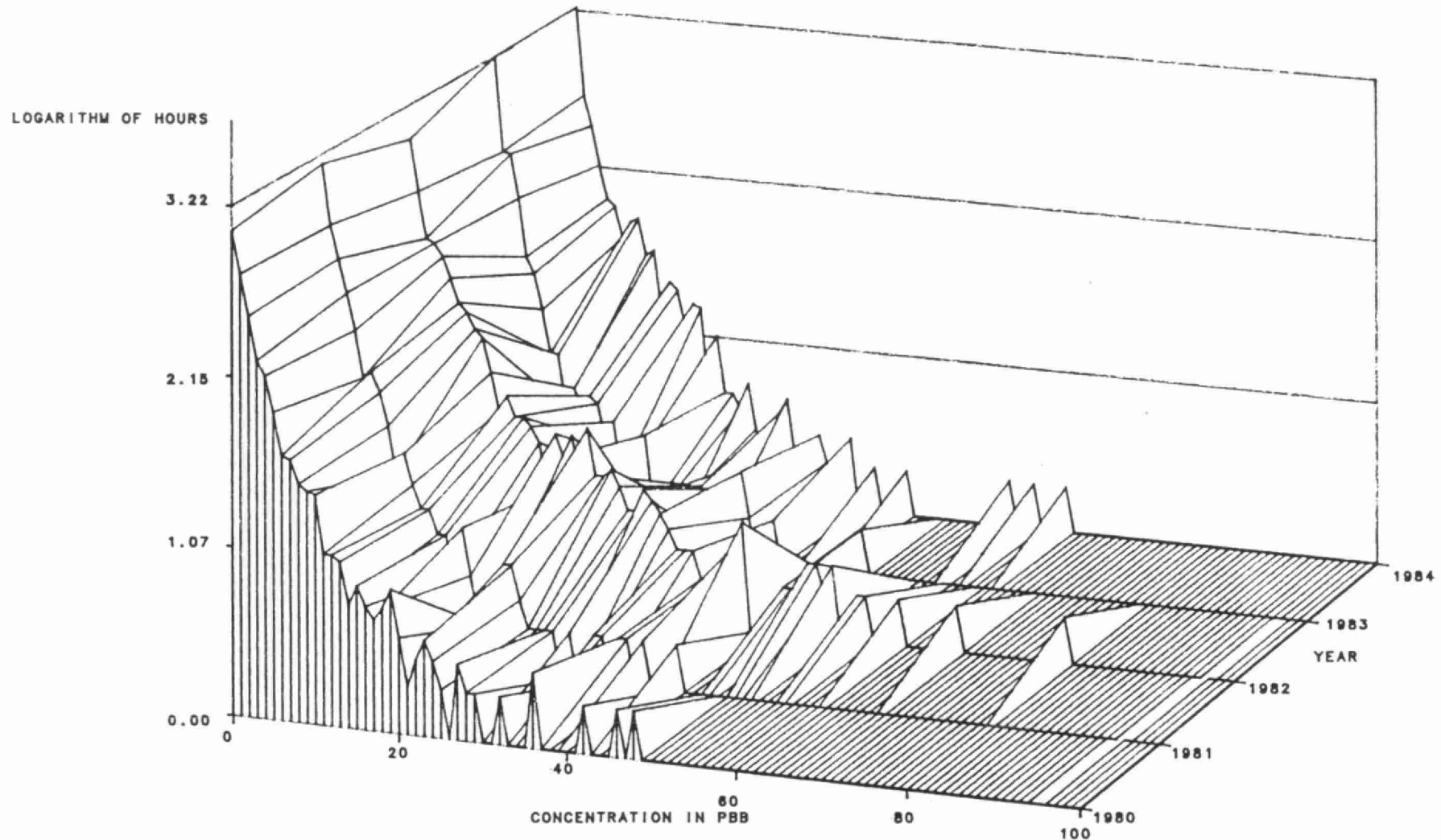
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LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

ONTARIO MINISTRY OF THE ENVIRONMENT

CORNWALL AMBIENT AIR DATA 1980 - 1984

VERTICAL AXIS IS LOGARITHMIC

SOURCE SPECIFIC BREAKDOWN
STATION=ST.FRANCIS SCHOOL ORIGIN=OTHER

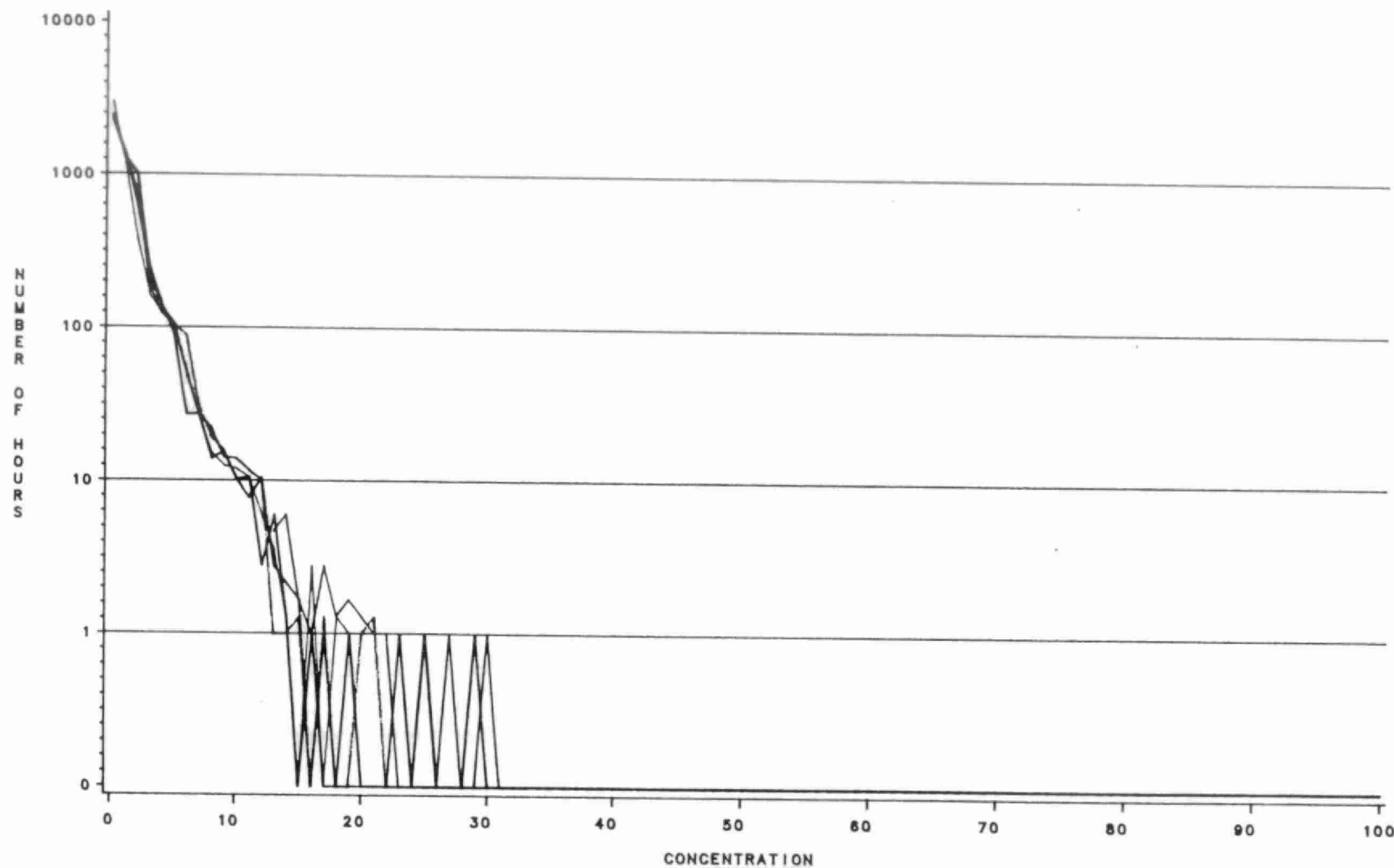


THREE DIMENSIONAL FREQUENCY ANALYSIS
LOGARITHM OF HOURS VERSUS CONCENTRATION VERSUS YEAR
WINDSPEED LESS THAN 3 KM/HR NOT INCLUDED

F3.8

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER-SULPHUR DIOXIDE



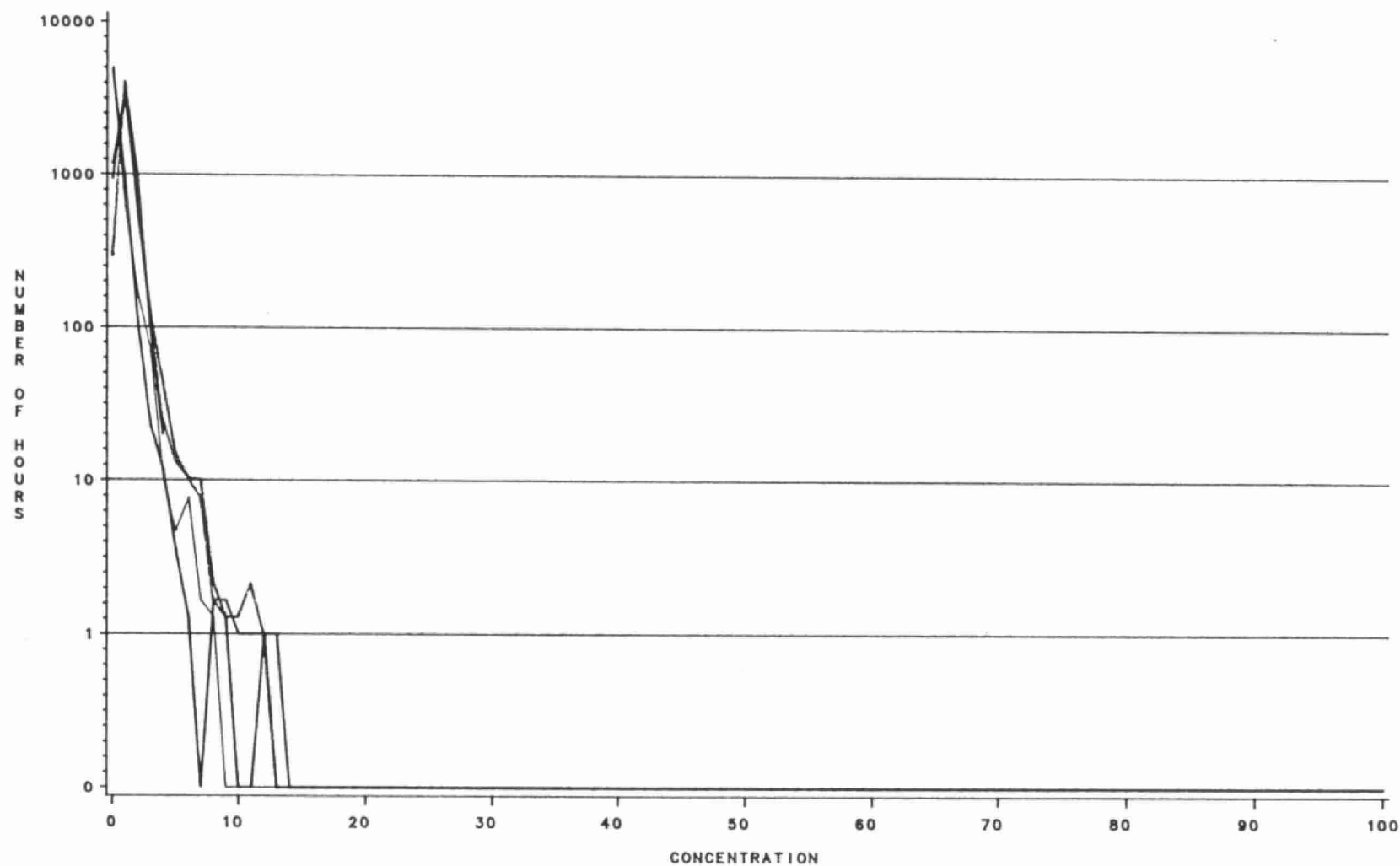
YEAR 1 2 3 4 5

PIECEWISE LINEAR INTERPOLATION
YEAR=1 ---1980 YEAR=2 ---1981
YEAR=3 ---1982 YEAR=4 ---1983
YEAR=5 ---1984

F.4.2

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER-CARBON MONOXIDE



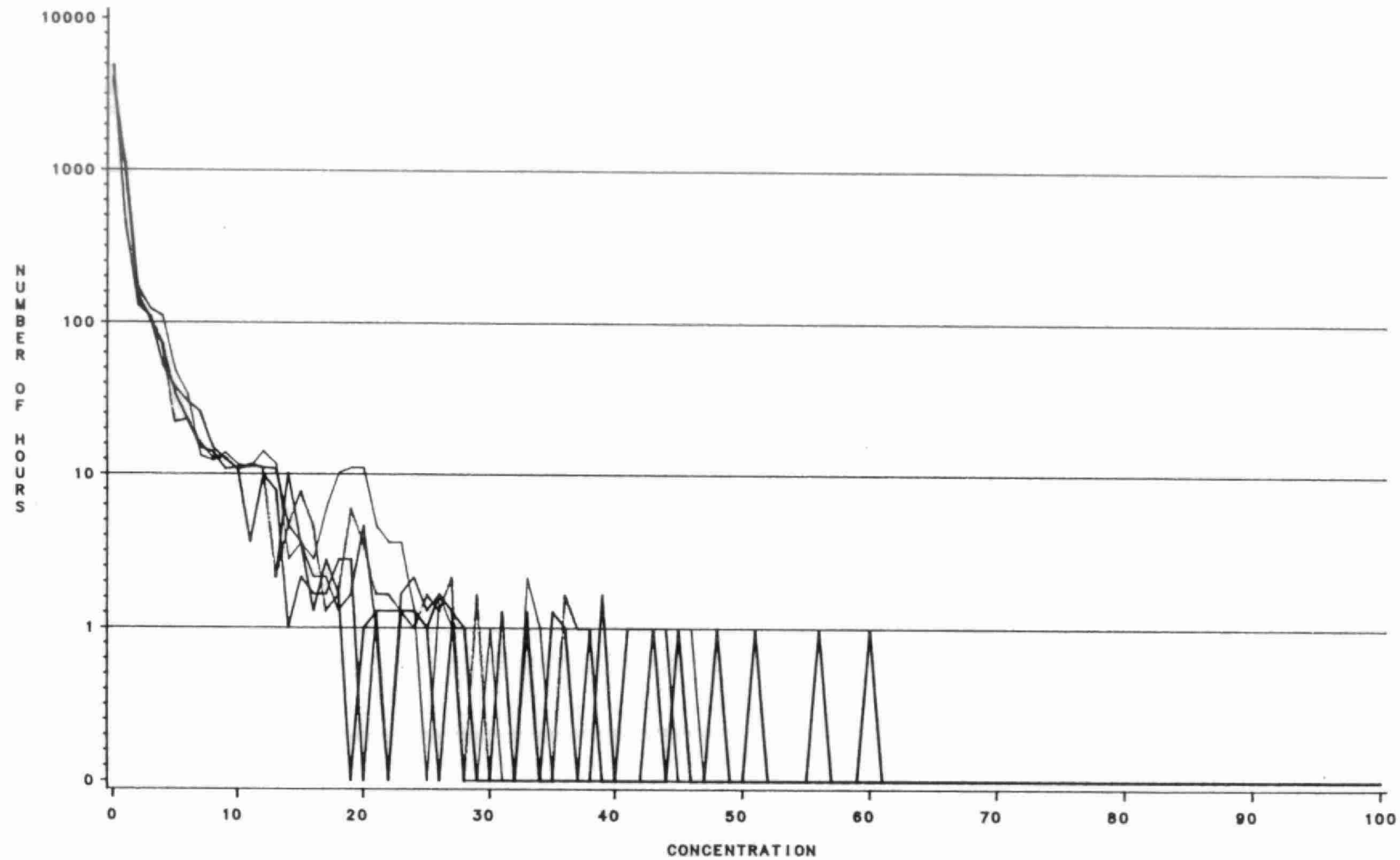
YEAR 1 2 3 4 5

PIECEWISE LINEAR INTERPOLATION
YEAR=1 ---1980 YEAR=2 ---1981
YEAR=3 ---1982 YEAR=4 ---1983
YEAR=5 ---1984

F 4.3

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER=NITRIC OXIDE



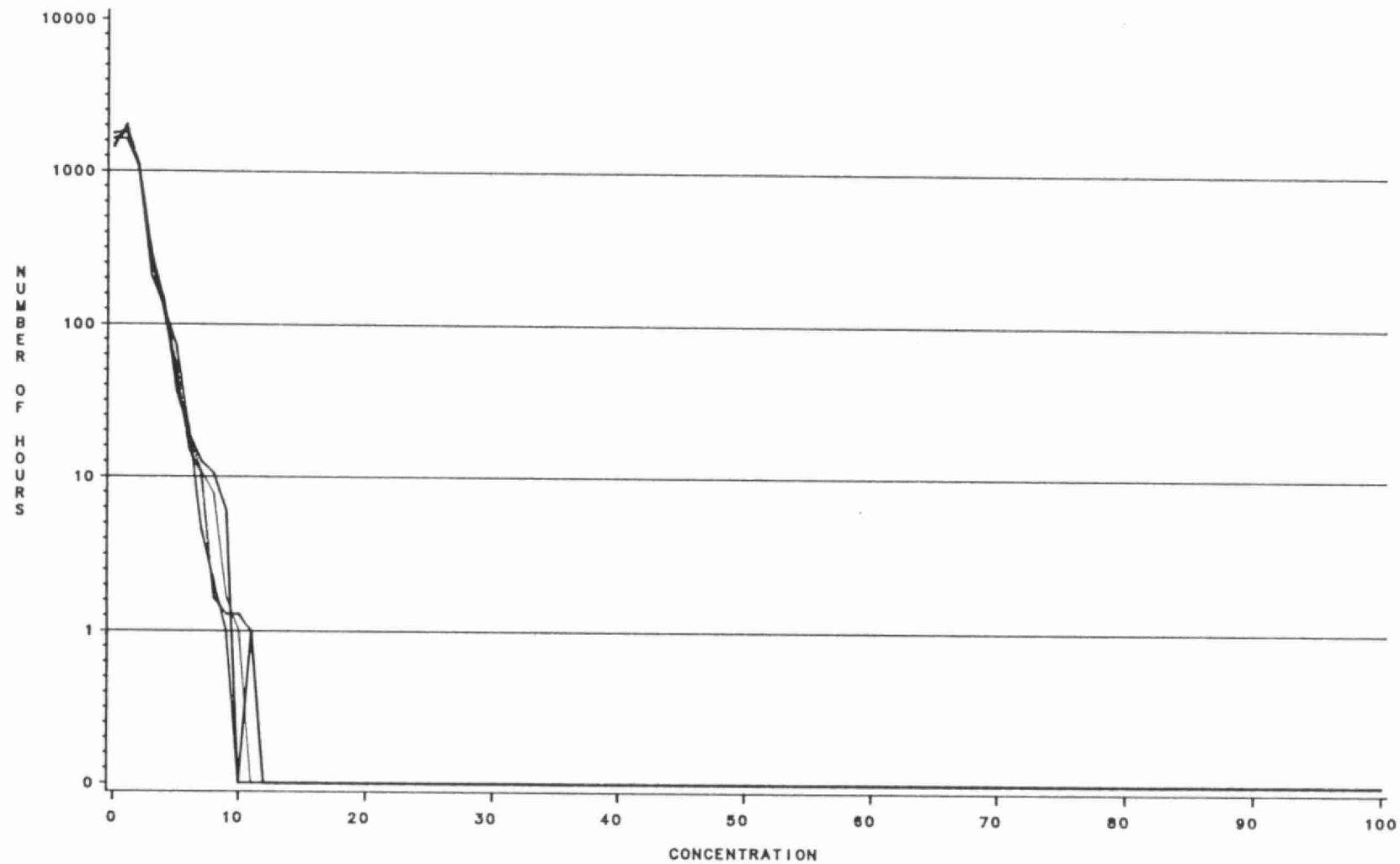
YEAR 1 2 3 4 5

PIECEWISE LINEAR INTERPOLATION
YEAR=1 ---1980 YEAR=2 ---1981
YEAR=3 ---1982 YEAR=4 ---1983
YEAR=5 ---1984

F 4.4

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER=NITROGEN DIOXIDE



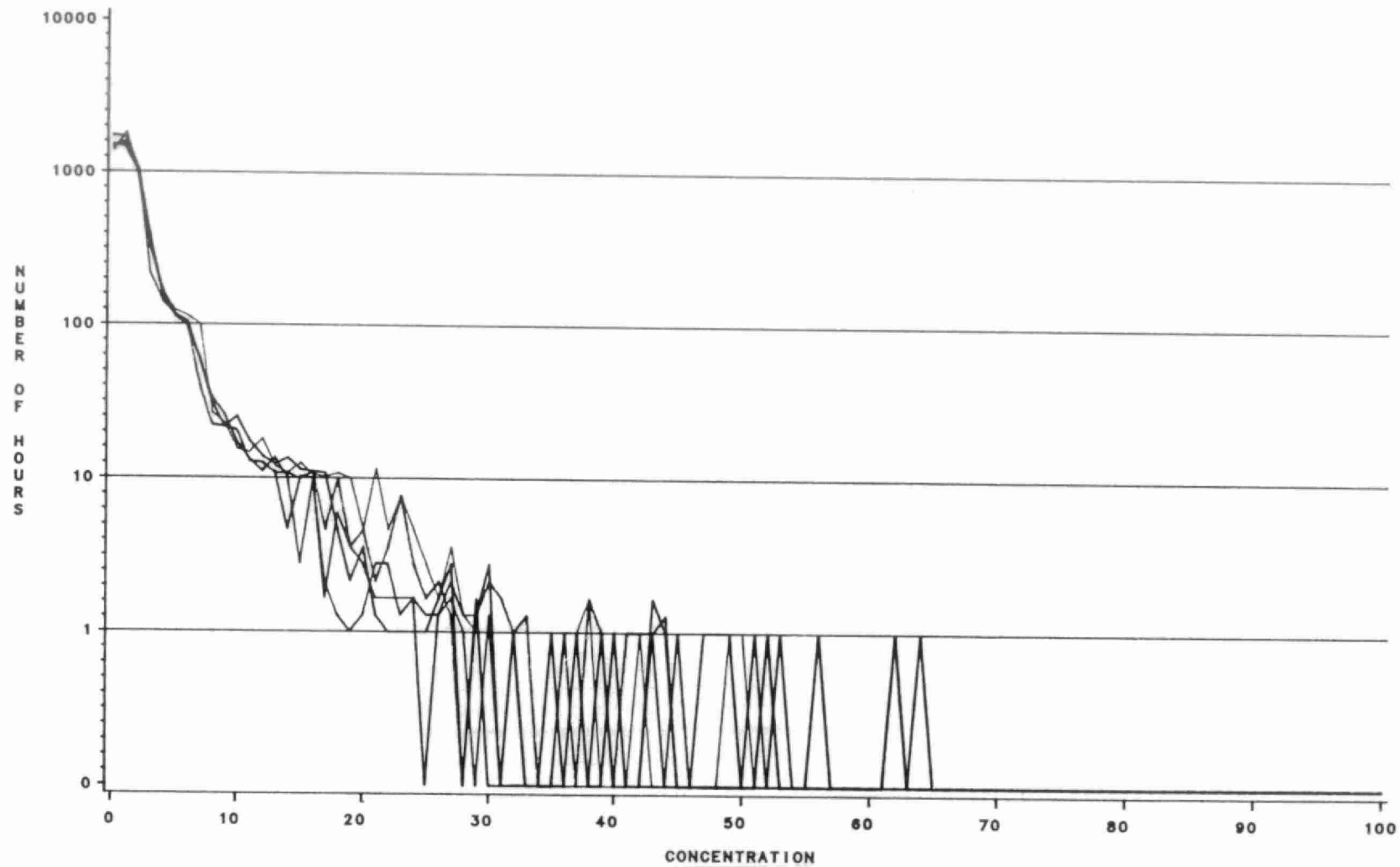
YEAR 1 2 3 4 5

PIECEWISE LINEAR INTERPOLATION
YEAR=1 ---1980 YEAR=2 ---1981
YEAR=3 ---1982 YEAR=4 ---1983
YEAR=5 ---1984

F 4.5

ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER-TOTAL NITROGEN OXIDES

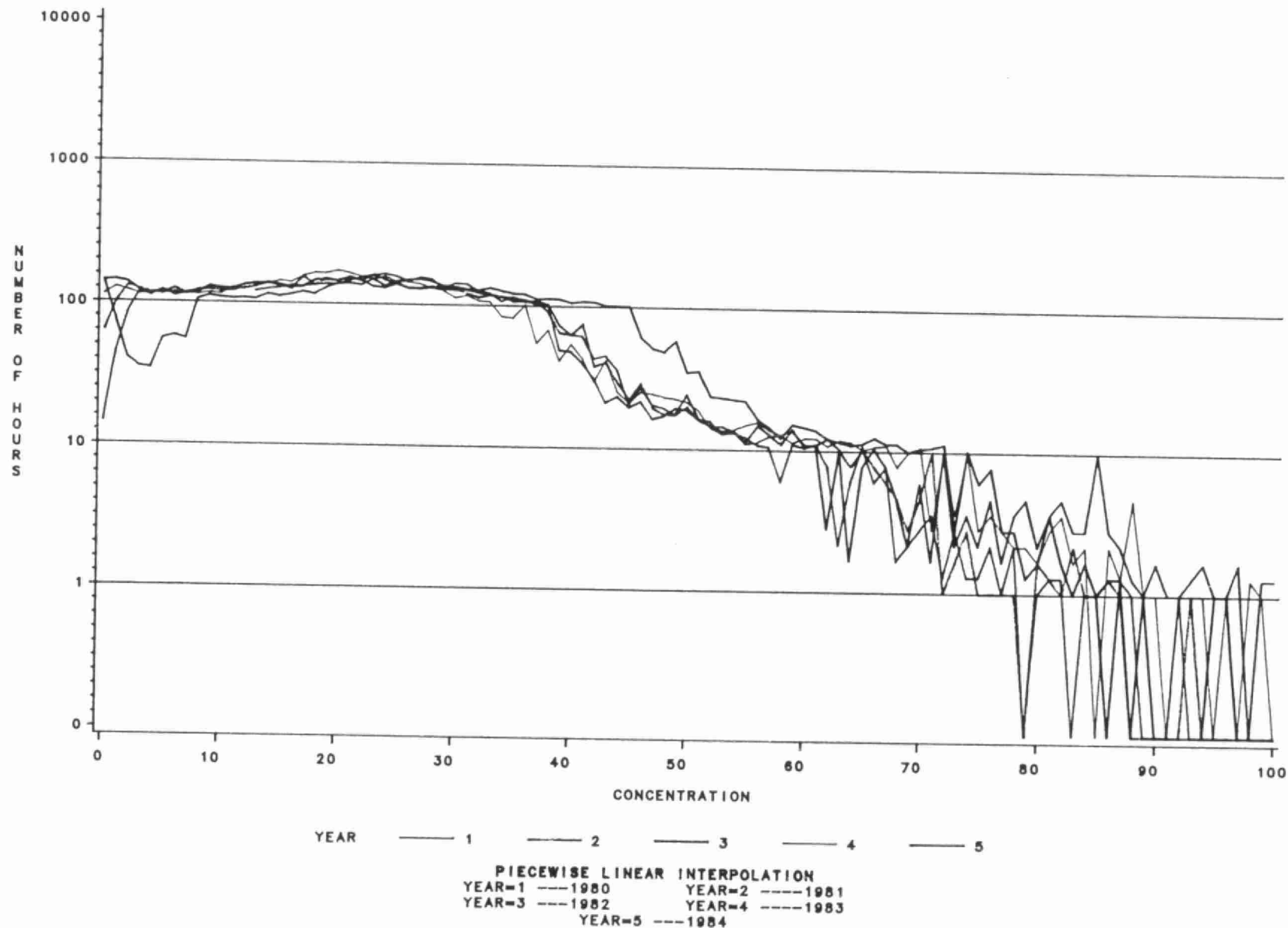


YEAR 1 2 3 4 5

PIECEWISE LINEAR INTERPOLATION
YEAR=1 ----1980 YEAR=2 ----1981
YEAR=3 ----1982 YEAR=4 ----1983
YEAR=5 ----1984

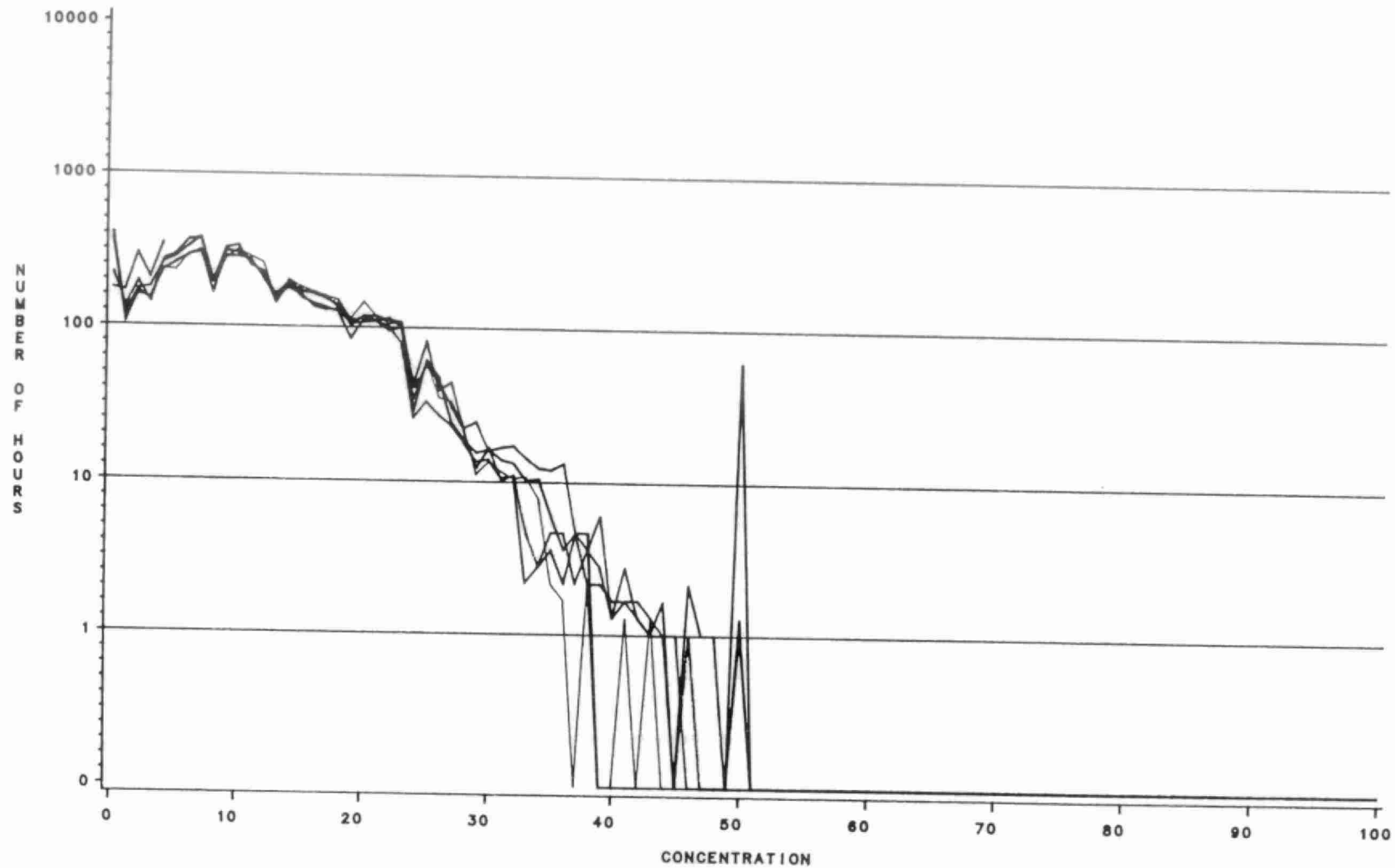
ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER-OZONE



ONTARIO MINISTRY OF THE ENVIRONMENT

SOUTHEASTERN REGION-AIR MONITORING
MULTI-YEAR FREQUENCY PLOTS FOR CORNWALL 1980-1984
PARAMETER=WIND SPEED



YEAR — 1 — 2 — 3 — 4 — 5

PIECEWISE LINEAR INTERPOLATION
YEAR=1 ---1980 YEAR=2 ---1981
YEAR=3 ---1982 YEAR=4 ---1983
YEAR=5 ---1984

RIO STRY IE E NMIE
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 CONCENTRATION DATA FOR 1980 TO 1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)		YEAR				
FREQUENCY	PERCENT					
ROW PCT	COL PCT	1980	1981	1982	1983	1984
ZERO		714	655	1033	614	762
		10.60	9.73	15.34	9.12	11.32
		18.90	17.34	27.34	16.25	20.17
		59.25	54.49	63.10	40.72	64.47
TRACE		189	272	314	398	147
		2.81	4.04	4.66	5.91	2.18
		14.32	20.61	23.79	30.15	11.14
		15.68	22.63	19.18	26.39	12.44
3-5		99	115	135	200	79
		1.47	1.71	2.00	2.97	1.17
		15.76	18.31	21.50	31.85	12.58
		8.22	9.57	8.25	13.26	6.68
6-10		89	74	71	162	74
		1.32	1.10	1.05	2.41	1.10
		18.94	15.74	15.11	34.47	15.74
		7.39	6.16	4.34	10.74	6.26
11-20		76	49	57	85	81
		1.13	0.73	0.85	1.26	1.20
		21.84	14.08	16.38	24.43	23.28
		6.31	4.08	3.48	5.64	6.85
21-26		17	12	11	28	22
		0.25	0.18	0.16	0.42	0.33
		18.89	13.33	12.22	31.11	24.44
		1.41	1.00	0.67	1.86	1.86
27 & OVER		21	25	16	21	17
		0.31	0.37	0.24	0.31	0.25
		21.00	25.00	16.00	21.00	17.00
		1.74	2.08	0.98	1.39	1.44
TOTAL		1205	1202	1637	1508	1182
		17.89	17.85	24.31	22.39	17.55
						6734
						100.00

FREQUENCY MISSING = 198

A6-1

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	545 8.40 17.60 47.43	473 7.29 15.28 42.81	687 10.59 22.19 43.07	816 12.58 26.36 52.51	575 8.86 18.57 53.00	3096 47.72
TRACE	249 3.84 18.71 21.67	246 3.79 18.48 22.26	370 5.70 27.80 23.20	310 4.78 23.29 19.95	156 2.40 11.72 14.38	1331 20.51
3-5	172 2.65 17.29 14.97	163 2.51 16.38 14.75	277 4.27 27.84 17.37	234 3.61 23.52 15.06	149 2.30 14.97 13.73	995 15.34
6-10	85 1.31 14.21 7.40	108 1.66 18.06 9.77	167 2.57 27.93 10.47	120 1.85 20.07 7.72	118 1.82 19.73 10.88	598 9.22
11-20	67 1.03 21.27 5.83	73 1.13 23.17 6.61	62 0.96 19.68 3.89	50 0.77 15.87 3.22	63 0.97 20.00 5.81	315 4.86
21-26	15 0.23 23.81 1.31	13 0.20 20.63 1.18	13 0.20 20.63 0.82	10 0.15 15.87 0.64	12 0.18 19.05 1.11	63 0.97
27 & OVER	16 0.25 17.78 1.39	29 0.45 32.22 2.62	19 0.29 21.11 1.19	14 0.22 15.56 0.90	12 0.18 13.33 1.11	90 1.39
TOTAL	1149 17.71	1105 17.03	1595 24.58	1554 23.95	1085 16.72	6488 100.00

FREQUENCY MISSING = 444

A6-2

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	948	1457	867	537	1408	5217
	7.13	10.96	6.52	4.04	10.59	39.25
	18.17	27.93	16.62	10.29	26.99	
	34.60	52.62	31.08	22.24	54.59	
TRACE	408	492	983	689	663	3235
	3.07	3.70	7.39	5.18	4.99	24.34
	12.61	15.21	30.39	21.30	20.49	
	14.89	17.77	35.23	28.53	25.71	
3-5	509	393	521	633	255	2311
	3.83	2.96	3.92	4.76	1.92	17.39
	22.03	17.01	22.54	27.39	11.03	
	18.58	14.19	18.67	26.21	9.89	
6-10	492	242	259	380	152	1525
	3.70	1.82	1.95	2.86	1.14	11.47
	32.26	15.87	16.98	24.92	9.97	
	17.96	8.74	9.28	15.73	5.89	
11-20	271	138	118	135	86	748
	2.04	1.04	0.89	1.02	0.65	5.63
	36.23	18.45	15.78	18.05	11.50	
	9.89	4.98	4.23	5.59	3.33	
21-26	61	22	17	13	12	125
	0.46	0.17	0.13	0.10	0.09	0.94
	48.80	17.60	13.60	10.40	9.60	
	2.23	0.79	0.61	0.54	0.47	
27 & OVER	51	25	25	28	3	132
	0.38	0.19	0.19	0.21	0.02	0.99
	38.64	18.94	18.94	21.21	2.27	
	1.86	0.90	0.90	1.16	0.12	
TOTAL	2740	2769	2790	2415	2579	13293
	20.61	20.83	20.99	18.17	19.40	100.00

FREQUENCY MISSING = 494

A6-3

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	572 4.65 17.11 23.62	1104 8.98 33.02 44.59	450 3.66 13.46 16.40	650 5.29 19.44 24.85	567 4.61 16.96 27.92	3343 27.20
TRACE	404 3.29 14.73 16.68	401 3.26 14.62 16.20	636 5.18 23.19 23.18	859 6.99 31.33 32.84	442 3.60 16.12 21.76	2742 22.31
3-5	426 3.47 18.15 17.59	360 2.93 15.34 14.54	656 5.34 27.95 23.91	609 4.96 25.95 23.28	296 2.41 12.61 14.57	2347 19.10
6-10	479 3.90 23.81 19.78	332 2.70 16.50 13.41	614 5.00 30.52 22.38	322 2.62 16.00 12.31	265 2.16 13.17 13.05	2012 16.37
11-20	370 3.01 28.40 15.28	178 1.45 13.66 7.19	298 2.42 22.87 10.86	125 1.02 9.59 4.78	332 2.70 25.48 16.35	1303 10.60
21-26	81 0.66 33.20 3.34	41 0.33 16.80 1.66	39 0.32 15.98 1.42	17 0.14 6.97 0.65	66 0.54 27.05 3.25	244 1.99
27 & OVER	90 0.73 30.20 3.72	60 0.49 20.13 2.42	51 0.42 17.11 1.86	34 0.28 11.41 1.30	63 0.51 21.14 3.10	298 2.42
TOTAL	2422 19.71	2476 20.15	2744 22.33	2616 21.29	2031 16.53	12289 100.00

FREQUENCY MISSING = 1498

A6-4

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	2165 14.60 21.49 70.68	2306 15.55 22.89 70.52	1845 12.44 18.32 68.06	1110 7.49 11.02 45.51	2647 17.85 26.28 79.11	10073 67.93
TRACE	516 3.48 18.74 16.85	655 4.42 23.78 20.03	569 3.84 20.66 20.99	650 4.38 23.60 26.65	364 2.45 13.22 10.88	2754 18.57
3-5	213 1.44 19.38 6.95	198 1.34 18.02 6.06	141 0.95 12.83 5.20	401 2.70 36.49 16.44	146 0.98 13.28 4.36	1099 7.41
6-10	94 0.63 19.38 3.07	61 0.41 12.58 1.87	83 0.56 17.11 3.06	173 1.17 35.67 7.09	74 0.50 15.26 2.21	485 3.27
11-20	52 0.35 18.44 1.70	36 0.24 12.77 1.10	36 0.24 12.77 1.33	66 0.45 23.40 2.71	92 0.62 32.62 2.75	282 1.90
21-26	11 0.07 16.92 0.36	13 0.09 20.00 0.40	12 0.08 18.46 0.44	19 0.13 29.23 0.78	10 0.07 15.38 0.30	65 0.44
27 & OVER	12 0.08 16.90 0.39	1 0.01 1.41 0.03	25 0.17 35.21 0.92	20 0.13 28.17 0.82	13 0.09 18.31 0.39	71 0.48
TOTAL	3063 20.66	3270 22.05	2711 18.28	2439 16.45	3346 22.56	14829 100.00

FREQUENCY MISSING = 497

A6-5

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	1142 8.12 17.18 41.20	1411 10.03 21.22 46.91	951 6.76 14.31 35.93	1484 10.55 22.32 57.39	1660 11.80 24.97 54.27	6648 47.24
TRACE	957 6.80 24.73 34.52	928 6.59 23.98 30.85	654 4.65 16.90 24.71	650 4.62 16.80 25.14	681 4.84 17.60 22.26	3870 27.50
3-5	410 2.91 21.34 14.79	403 2.86 20.98 13.40	497 3.53 25.87 18.78	308 2.19 16.03 11.91	303 2.15 15.77 9.91	1921 13.65
6-10	176 1.25 17.60 6.35	187 1.33 18.70 6.22	303 2.15 30.30 11.45	84 0.60 8.40 3.25	250 1.78 25.00 8.17	1000 7.11
11-20	68 0.48 15.49 2.45	58 0.41 13.21 1.93	136 0.97 30.98 5.14	45 0.32 10.25 1.74	132 0.94 30.07 4.32	439 3.12
21-26	9 0.06 9.57 0.32	12 0.09 12.77 0.40	50 0.36 53.19 1.89	7 0.05 7.45 0.27	16 0.11 17.02 0.52	94 0.67
27 & OVER	10 0.07 10.00 0.36	9 0.06 9.00 0.30	56 0.40 56.00 2.12	8 0.06 8.00 0.31	17 0.12 17.00 0.56	100 0.71
TOTAL	2772 19.70	3008 21.38	2647 18.81	2586 18.38	3059 21.74	14072 100.00

FREQUENCY MISSING = 1254

A6-6

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	944 13.78 24.07 58.49	775 11.31 19.76 56.53	752 10.97 19.17 54.61	397 5.79 10.12 40.18	1054 15.38 26.87 70.17	3922 57.24
TRACE	360 5.25 23.14 22.30	352 5.14 22.62 25.67	360 5.25 23.14 26.14	242 3.53 15.55 24.49	242 3.53 15.55 16.11	1556 22.71
3-5	146 2.13 20.59 9.05	152 2.22 21.44 11.09	151 2.20 21.30 10.97	159 2.32 22.43 16.09	101 1.47 14.25 6.72	709 10.35
6-10	99 1.44 25.58 6.13	64 0.93 16.54 4.67	73 1.07 18.86 5.30	96 1.40 24.81 9.72	55 0.80 14.21 3.66	387 5.65
11-20	47 0.69 22.07 2.91	20 0.29 9.39 1.46	31 0.45 14.55 2.25	71 1.04 33.33 7.19	44 0.64 20.66 2.93	213 3.11
21-26	8 0.12 28.57 0.50	4 0.06 14.29 0.29	6 0.09 21.43 0.44	6 0.09 21.43 0.61	4 0.06 14.29 0.27	28 0.41
27 & OVER	10 0.15 27.03 0.62	4 0.06 10.81 0.29	4 0.06 10.81 0.29	17 0.25 45.95 1.72	2 0.03 5.41 0.13	37 0.54
TOTAL	1614 23.56	1371 20.01	1377 20.10	988 14.42	1502 21.92	6852 100.00

FREQUENCY MISSING = 207

A6-7

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	393	454	358	353	618	2176
	6.05	6.99	5.51	5.43	9.51	33.49
	18.06	20.86	16.45	16.22	28.40	
	27.29	35.78	26.19	32.56	46.19	
TRACE	390	322	373	268	347	1700
	6.00	4.96	5.74	4.12	5.34	26.16
	22.94	18.94	21.94	15.76	20.41	
	27.08	25.37	27.29	24.72	25.93	
3-5	321	248	251	197	155	1172
	4.94	3.82	3.86	3.03	2.39	18.04
	27.39	21.16	21.42	16.81	13.23	
	22.29	19.54	18.36	18.17	11.58	
6-10	150	136	204	137	104	731
	2.31	2.09	3.14	2.11	1.60	11.25
	20.52	18.60	27.91	18.74	14.23	
	10.42	10.72	14.92	12.64	7.77	
11-20	115	82	105	82	90	474
	1.77	1.26	1.62	1.26	1.39	7.29
	24.26	17.30	22.15	17.30	18.99	
	7.99	6.46	7.68	7.56	6.73	
21-26	27	12	24	14	16	93
	0.42	0.18	0.37	0.22	0.25	1.43
	29.03	12.90	25.81	15.05	17.20	
	1.88	0.95	1.76	1.29	1.20	
27 & OVER	44	15	52	33	8	152
	0.68	0.23	0.80	0.51	0.12	2.34
	28.95	9.87	34.21	21.71	5.26	
	3.06	1.18	3.80	3.04	0.60	
TOTAL	1440	1269	1367	1084	1338	6498
	22.16	19.53	21.04	16.68	20.59	100.00

FREQUENCY MISSING = 561

A6-8

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1002 14.88 17.50 83.15	1042 15.47 18.20 86.69	1482 22.01 25.88 90.53	1212 18.00 21.17 80.37	988 14.67 17.25 83.59	5726 85.03
GOOD	89 1.32 18.94 7.39	74 1.10 15.74 6.16	71 1.05 15.11 4.34	162 2.41 34.47 10.74	74 1.10 15.74 6.26	470 6.98
MODERATE	97 1.44 21.46 8.05	62 0.92 13.72 5.16	70 1.04 15.49 4.28	116 1.72 25.66 7.69	107 1.59 23.67 9.05	452 6.71
POOR	17 0.25 19.77 1.41	24 0.36 27.91 2.00	14 0.21 16.28 0.86	18 0.27 20.93 1.19	13 0.19 15.12 1.10	86 1.28
TOTAL	1205 17.89	1202 17.85	1637 24.31	1508 22.39	1182 17.55	6734 100.00

FREQUENCY MISSING = 198

A6-9

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	966	882	1334	1360	880	5422
	14.89	13.59	20.56	20.96	13.56	83.57
	17.82	16.27	24.60	25.08	16.23	
	84.07	79.82	83.64	87.52	81.11	
GOOD	85	108	167	120	118	598
	1.31	1.66	2.57	1.85	1.82	9.22
	14.21	18.06	27.93	20.07	19.73	
	7.40	9.77	10.47	7.72	10.88	
MODERATE	88	86	76	63	75	388
	1.36	1.33	1.17	0.97	1.16	5.98
	22.68	22.16	19.59	16.24	19.33	
	7.66	7.78	4.76	4.05	6.91	
POOR	10	29	18	11	12	80
	0.15	0.45	0.28	0.17	0.18	1.23
	12.50	36.25	22.50	13.75	15.00	
	0.87	2.62	1.13	0.71	1.11	
TOTAL	1149	1105	1595	1554	1085	6488
	17.71	17.03	24.58	23.95	16.72	100.00

FREQUENCY MISSING = 444

A6-10

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1865 14.03 17.33 68.07	2342 17.62 21.76 84.58	2371 17.84 22.03 84.98	1859 13.98 17.27 76.98	2326 17.50 21.61 90.19	10763 80.97
GOOD	492 3.70 32.26 17.96	242 1.82 15.87 8.74	259 1.95 16.98 9.28	380 2.86 24.92 15.73	152 1.14 9.97 5.89	1525 11.47
MODERATE	338 2.54 38.19 12.34	162 1.22 18.31 5.85	138 1.04 15.59 4.95	149 1.12 16.84 6.17	98 0.74 11.07 3.80	885 6.66
POOR	45 0.34 37.50 1.64	23 0.17 19.17 0.83	22 0.17 18.33 0.79	27 0.20 22.50 1.12	3 0.02 2.50 0.12	120 0.90
TOTAL	2740 20.61	2769 20.83	2790 20.99	2415 18.17	2579 19.40	13293 100.00

FREQUENCY MISSING = 494

A6-11

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1402	1865	1742	2118	1305	8432
	11.41	15.18	14.18	17.23	10.62	68.61
	16.63	22.12	20.66	25.12	15.48	
	57.89	75.32	63.48	80.96	64.25	
GOOD	479	332	614	322	265	2012
	3.90	2.70	5.00	2.62	2.16	16.37
	23.81	16.50	30.52	16.00	13.17	
	19.78	13.41	22.38	12.31	13.05	
MODERATE	462	223	338	146	405	1574
	3.76	1.81	2.75	1.19	3.30	12.81
	29.35	14.17	21.47	9.28	25.73	
	19.08	9.01	12.32	5.58	19.94	
POOR	79	56	50	30	56	271
	0.64	0.46	0.41	0.24	0.46	2.21
	29.15	20.66	18.45	11.07	20.66	
	3.26	2.26	1.82	1.15	2.76	
TOTAL	2422	2476	2744	2616	2031	12289
	19.71	20.15	22.33	21.29	16.53	100.00

FREQUENCY MISSING = 1498

A6-12

SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)		YEAR				
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	2894	3159	2555	2161	3157	13926
	19.52	21.30	17.23	14.57	21.29	93.91
	20.78	22.68	18.35	15.52	22.67	
	94.48	96.61	94.25	88.60	94.35	
GOOD	94	61	83	173	74	485
	0.63	0.41	0.56	1.17	0.50	3.27
	19.38	12.58	17.11	35.67	15.26	
	3.07	1.87	3.06	7.09	2.21	
MODERATE	64	49	51	85	104	353
	0.43	0.33	0.34	0.57	0.70	2.38
	18.13	13.88	14.45	24.08	29.46	
	2.09	1.50	1.88	3.49	3.11	
POOR	11	1	22	20	11	65
	0.07	0.01	0.15	0.13	0.07	0.44
	16.92	1.54	33.85	30.77	16.92	
	0.36	0.03	0.81	0.82	0.33	
TOTAL	3063	3270	2711	2439	3346	14829
	20.66	22.05	18.28	16.45	22.56	100.00

FREQUENCY MISSING = 497

A6-13

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)		YEAR				
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	2509	2742	2102	2442	2644	12439
	17.83	19.49	14.94	17.35	18.79	88.40
	20.17	22.04	16.90	19.63	21.26	
	90.51	91.16	79.41	94.43	86.43	
GOOD	176	187	303	84	250	1000
	1.25	1.33	2.15	0.60	1.78	7.11
	17.60	18.70	30.30	8.40	25.00	
	6.35	6.22	11.45	3.25	8.17	
MODERATE	79	71	190	52	152	544
	0.56	0.50	1.35	0.37	1.08	3.87
	14.52	13.05	34.93	9.56	27.94	
	2.85	2.36	7.18	2.01	4.97	
POOR	8	8	52	8	13	89
	0.06	0.06	0.37	0.06	0.09	0.63
	8.99	8.99	58.43	8.99	14.61	
	0.29	0.27	1.96	0.31	0.42	
TOTAL	2772	3008	2647	2586	3059	14072
	19.70	21.38	18.81	18.38	21.74	100.00

FREQUENCY MISSING = 1254

A6-14

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1450 21.16 23.44 89.84	1279 18.67 20.67 93.29	1263 18.43 20.41 91.72	798 11.65 12.90 80.77	1397 20.39 22.58 93.01	6187 90.29
GOOD	99 1.44 25.58 6.13	64 0.93 16.54 4.67	73 1.07 18.86 5.30	96 1.40 24.81 9.72	55 0.80 14.21 3.66	387 5.65
MODERATE	55 0.80 22.63 3.41	24 0.35 9.88 1.75	38 0.55 15.64 2.76	78 1.14 32.10 7.89	48 0.70 19.75 3.20	243 3.55
POOR	10 0.15 28.57 0.62	4 0.06 11.43 0.29	3 0.04 8.57 0.22	16 0.23 45.71 1.62	2 0.03 5.71 0.13	35 0.51
TOTAL	1614 23.56	1371 20.01	1377 20.10	988 14.42	1502 21.92	6852 100.00

FREQUENCY MISSING = 207

A6-15

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 3 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1104	1024	982	818	1120	5048
	16.99	15.76	15.11	12.59	17.24	77.69
	21.87	20.29	19.45	16.20	22.19	
	76.67	80.69	71.84	75.46	83.71	
GOOD	150	136	204	137	104	731
	2.31	2.09	3.14	2.11	1.60	11.25
	20.52	18.60	27.91	18.74	14.23	
	10.42	10.72	14.92	12.64	7.77	
MODERATE	142	96	132	96	106	572
	2.19	1.48	2.03	1.48	1.63	8.80
	24.83	16.78	23.08	16.78	18.53	
	9.86	7.57	9.66	8.86	7.92	
POOR	44	13	49	33	8	147
	0.68	0.20	0.75	0.51	0.12	2.26
	29.93	8.84	33.33	22.45	5.44	
	3.06	1.02	3.58	3.04	0.60	
TOTAL	1440	1269	1367	1084	1338	6498
	22.16	19.53	21.04	16.68	20.59	100.00

FREQUENCY MISSING = 561

A6-16

SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 CONCENTRATION DATA FOR 1980 TO 1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	619 10.30 18.35 60.04	592 9.85 17.55 55.33	929 15.46 27.53 63.03	562 9.35 16.66 40.52	672 11.18 19.92 64.12	3374 56.14
TRACE	150 2.50 13.08 14.55	227 3.78 19.79 21.21	282 4.69 24.59 19.13	362 6.02 31.56 26.10	126 2.10 10.99 12.02	1147 19.08
3-5	87 1.45 15.16 8.44	104 1.73 18.12 9.72	123 2.05 21.43 8.34	189 3.14 32.93 13.63	71 1.18 12.37 6.77	574 9.55
6-10	79 1.31 18.63 7.66	69 1.15 16.27 6.45	60 1.00 14.15 4.07	149 2.48 35.14 10.74	67 1.11 15.80 6.39	424 7.05
11-20	69 1.15 21.36 6.69	46 0.77 14.24 4.30	55 0.92 17.03 3.73	79 1.31 24.46 5.70	74 1.23 22.91 7.06	323 5.37
21-26	11 0.18 13.58 1.07	12 0.20 14.81 1.12	10 0.17 12.35 0.68	26 0.43 32.10 1.87	22 0.37 27.16 2.10	81 1.35
27 & OVER	16 0.27 18.39 1.55	20 0.33 22.99 1.87	15 0.25 17.24 1.02	20 0.33 22.99 1.44	16 0.27 18.39 1.53	87 1.45
TOTAL	1031 17.15	1070 17.80	1474 24.53	1387 23.08	1048 17.44	6010 100.00

FREQUENCY MISSING = 177

A6-17

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	481	414	616	768	527	2806
	8.29	7.14	10.62	13.24	9.09	48.38
	17.14	14.75	21.95	27.37	18.78	
	49.03	42.42	42.75	53.97	53.83	
TRACE	202	208	339	273	131	1153
	3.48	3.59	5.84	4.71	2.26	19.88
	17.52	18.04	29.40	23.68	11.36	
	20.59	21.31	23.53	19.18	13.38	
3-5	144	145	247	212	134	882
	2.48	2.50	4.26	3.66	2.31	15.21
	16.33	16.44	28.00	24.04	15.19	
	14.68	14.86	17.14	14.90	13.69	
6-10	72	104	147	104	106	533
	1.24	1.79	2.53	1.79	1.83	9.19
	13.51	19.51	27.58	19.51	19.89	
	7.34	10.66	10.20	7.31	10.83	
11-20	57	67	60	42	59	285
	0.98	1.16	1.03	0.72	1.02	4.91
	20.00	23.51	21.05	14.74	20.70	
	5.81	6.86	4.16	2.95	6.03	
21-26	13	13	13	10	10	59
	0.22	0.22	0.22	0.17	0.17	1.02
	22.03	22.03	22.03	16.95	16.95	
	1.33	1.33	0.90	0.70	1.02	
27 & OVER	12	25	19	14	12	82
	0.21	0.43	0.33	0.24	0.21	1.41
	14.63	30.49	23.17	17.07	14.63	
	1.22	2.56	1.32	0.98	1.23	
TOTAL	981	976	1441	1423	979	5800
	16.91	16.83	24.84	24.53	16.88	100.00

FREQUENCY MISSING = 387

A6-18

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 CONCENTRATION DATA FOR 1980 TO 1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	796 6.62 17.33 32.81	1325 11.02 28.85 52.35	789 6.56 17.18 30.71	468 3.89 10.19 21.42	1214 10.10 26.44 52.46	4592 38.19
TRACE	351 2.92 11.91 14.47	441 3.67 14.96 17.42	914 7.60 31.00 35.58	627 5.21 21.27 28.70	615 5.11 20.86 26.58	2948 24.52
3-5	465 3.87 21.75 19.17	366 3.04 17.12 14.46	489 4.07 22.87 19.03	574 4.77 26.85 26.27	244 2.03 11.41 10.54	2138 17.78
6-10	461 3.83 32.40 19.00	231 1.92 16.23 9.13	233 1.94 16.37 9.07	352 2.93 24.74 16.11	146 1.21 10.26 6.31	1423 11.83
11-20	254 2.11 36.55 10.47	126 1.05 18.13 4.98	109 0.91 15.68 4.24	126 1.05 18.13 5.77	80 0.67 11.51 3.46	695 5.78
21-26	54 0.45 48.21 2.23	20 0.17 17.86 0.79	15 0.12 13.39 0.58	11 0.09 9.82 0.50	12 0.10 10.71 0.52	112 0.93
27 & OVER	45 0.37 38.46 1.85	22 0.18 18.80 0.87	20 0.17 17.09 0.78	27 0.22 23.08 1.24	3 0.02 2.56 0.13	117 0.97
TOTAL	2426 20.17	2531 21.05	2569 21.36	2185 18.17	2314 19.24	12025 100.00

FREQUENCY MISSING = 436

A6-19

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	491 4.43 16.32 23.04	1017 9.17 33.81 45.16	418 3.77 13.90 16.56	579 5.22 19.25 24.60	503 4.54 16.72 27.53	3008 27.13
TRACE	350 3.16 14.01 16.42	365 3.29 14.61 16.21	593 5.35 23.73 23.49	794 7.16 31.77 33.73	397 3.58 15.89 21.73	2499 22.54
3-5	393 3.54 18.21 18.44	328 2.96 15.20 14.56	607 5.47 28.13 24.05	562 5.07 26.04 23.87	268 2.42 12.42 14.67	2158 19.46
6-10	435 3.92 23.54 20.41	309 2.79 16.72 13.72	579 5.22 31.33 22.94	286 2.58 15.48 12.15	239 2.16 12.93 13.08	1848 16.67
11-20	324 2.92 28.42 15.20	156 1.41 13.68 6.93	262 2.36 22.98 10.38	103 0.93 9.04 4.38	295 2.66 25.88 16.15	1140 10.28
21-26	72 0.65 34.29 3.38	34 0.31 16.19 1.51	32 0.29 15.24 1.27	9 0.08 4.29 0.38	63 0.57 30.00 3.45	210 1.89
27 & OVER	66 0.60 29.33 3.10	43 0.39 19.11 1.91	33 0.30 14.67 1.31	21 0.19 9.33 0.89	62 0.56 27.56 3.39	225 2.03
TOTAL	2131 19.22	2252 20.31	2524 22.76	2354 21.23	1827 16.48	11088 100.00

FREQUENCY MISSING = 1373

A6-20

SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 CONCENTRATION DATA FOR 1980 TO 1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	1840 13.93 20.63 69.30	2069 15.66 23.19 70.30	1662 12.58 18.63 68.37	1001 7.58 11.22 45.31	2349 17.78 26.33 79.01	8921 67.53
TRACE	471 3.57 18.94 17.74	599 4.53 24.09 20.35	506 3.83 20.35 20.81	583 4.41 23.44 26.39	328 2.48 13.19 11.03	2487 18.83
3-5	197 1.49 19.70 7.42	172 1.30 17.20 5.84	128 0.97 12.80 5.27	371 2.81 37.10 16.79	132 1.00 13.20 4.44	1000 7.57
6-10	83 0.63 19.39 3.13	56 0.42 13.08 1.90	67 0.51 15.65 2.76	157 1.19 36.68 7.11	65 0.49 15.19 2.19	428 3.24
11-20	47 0.36 18.36 1.77	34 0.26 13.28 1.16	32 0.24 12.50 1.32	60 0.45 23.44 2.72	83 0.63 32.42 2.79	256 1.94
21-26	7 0.05 12.07 0.26	12 0.09 20.69 0.41	12 0.09 20.69 0.49	19 0.14 32.76 0.86	8 0.06 13.79 0.27	58 0.44
27 & OVER	10 0.08 16.39 0.38	1 0.01 1.64 0.03	24 0.18 39.34 0.99	18 0.14 29.51 0.81	8 0.06 13.11 0.27	61 0.46
TOTAL	2655 20.10	2943 22.28	2431 18.40	2209 16.72	2973 22.50	13211 100.00

FREQUENCY MISSING = 448

A6-21

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)		YEAR				
FREQUENCY	PERCENT					
ROW PCT	COL PCT					
		1980	1981	1982	1983	1984
						TOTAL
ZERO		987	1233	862	1360	1512
		7.88	9.84	6.88	10.86	12.07
		16.58	20.71	14.48	22.84	25.39
		41.40	45.68	36.25	58.37	55.30
TRACE		810	864	583	578	578
		6.47	6.90	4.65	4.61	4.61
		23.73	25.31	17.08	16.94	16.94
		33.98	32.01	24.52	24.81	21.14
3-5		356	367	425	267	271
		2.84	2.93	3.39	2.13	2.16
		21.12	21.77	25.21	15.84	16.07
		14.93	13.60	17.87	11.46	9.91
6-10		156	167	277	72	230
		1.25	1.33	2.21	0.57	1.84
		17.29	18.51	30.71	7.98	25.50
		6.54	6.19	11.65	3.09	8.41
11-20		59	50	128	40	116
		0.47	0.40	1.02	0.32	0.93
		15.01	12.72	32.57	10.18	29.52
		2.47	1.85	5.38	1.72	4.24
21-26		8	11	49	6	13
		0.06	0.09	0.39	0.05	0.10
		9.20	12.64	56.32	6.90	14.94
		0.34	0.41	2.06	0.26	0.48
27 & OVER		8	7	54	7	14
		0.06	0.06	0.43	0.06	0.11
		8.89	7.78	60.00	7.78	15.56
		0.34	0.26	2.27	0.30	0.51
TOTAL		2384	2699	2378	2330	2734
		19.03	21.55	18.99	18.60	21.83
						100.00

FREQUENCY MISSING = 1134

A6-22

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 CONCENTRATION DATA FOR 1980 TO 1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	1516 14.49 24.84 60.40	1207 11.54 19.78 58.37	1117 10.68 18.30 54.73	627 5.99 10.27 39.96	1636 15.64 26.81 71.94	6103 58.33
TRACE	501 4.79 21.94 19.96	504 4.82 22.08 24.37	524 5.01 22.95 25.67	407 3.89 17.83 25.94	347 3.32 15.20 15.26	2283 21.82
3-5	218 2.08 21.06 8.69	216 2.06 20.87 10.44	208 1.99 20.10 10.19	259 2.48 25.02 16.51	134 1.28 12.95 5.89	1035 9.89
6-10	151 1.44 25.51 6.02	85 0.81 14.36 4.11	126 1.20 21.28 6.17	153 1.46 25.84 9.75	77 0.74 13.01 3.39	592 5.66
11-20	76 0.73 23.97 3.03	37 0.35 11.67 1.79	46 0.44 14.51 2.25	92 0.88 29.02 5.86	66 0.63 20.82 2.90	317 3.03
21-26	25 0.24 43.86 1.00	7 0.07 12.28 0.34	9 0.09 15.79 0.44	10 0.10 17.54 0.64	6 0.06 10.53 0.26	57 0.54
27 & OVER	23 0.22 30.67 0.92	12 0.11 16.00 0.58	11 0.11 14.67 0.54	21 0.20 28.00 1.34	8 0.08 10.67 0.35	75 0.72
TOTAL	2510 23.99	2068 19.77	2041 19.51	1569 15.00	2274 21.74	10462 100.00

FREQUENCY MISSING = 335

A6-23

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
CONCENTRATION DATA FOR 1980 TO 1984
WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
ZERO	693 6.98 19.83 30.30	778 7.83 22.26 40.29	550 5.54 15.74 27.36	596 6.00 17.05 34.39	878 8.84 25.12 44.50	3495 35.18
TRACE	638 6.42 24.75 27.90	460 4.63 17.84 23.82	518 5.21 20.09 25.77	442 4.45 17.15 25.50	520 5.23 20.17 26.36	2578 25.95
3-5	436 4.39 25.51 19.06	334 3.36 19.54 17.30	402 4.05 23.52 20.00	307 3.09 17.96 17.71	230 2.32 13.46 11.66	1709 17.20
6-10	227 2.29 21.46 9.93	183 1.84 17.30 9.48	285 2.87 26.94 14.18	201 2.02 19.00 11.60	162 1.63 15.31 8.21	1058 10.65
11-20	180 1.81 25.25 7.87	118 1.19 16.55 6.11	151 1.52 21.18 7.51	117 1.18 16.41 6.75	147 1.48 20.62 7.45	713 7.18
21-26	39 0.39 28.26 1.71	20 0.20 14.49 1.04	32 0.32 23.19 1.59	23 0.23 16.67 1.33	24 0.24 17.39 1.22	138 1.39
27 & OVER	74 0.74 30.45 3.24	38 0.38 15.64 1.97	72 0.72 29.63 3.58	47 0.47 19.34 2.71	12 0.12 4.94 0.61	243 2.45
TOTAL	2287 23.02	1931 19.44	2010 20.23	1733 17.45	1973 19.86	9934 100.00

FREQUENCY MISSING = 863

A6-24

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)						YEAR
FREQUENCY PERCENT ROW PCT COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	856	923	1334	1113	869	5095
	14.24	15.36	22.20	18.52	14.46	84.78
	16.80	18.12	26.18	21.84	17.06	
	83.03	86.26	90.50	80.25	82.92	
GOOD	79	69	60	149	67	424
	1.31	1.15	1.00	2.48	1.11	7.05
	18.63	16.27	14.15	35.14	15.80	
	7.66	6.45	4.07	10.74	6.39	
MODERATE	84	59	67	107	100	417
	1.40	0.98	1.11	1.78	1.66	6.94
	20.14	14.15	16.07	25.66	23.98	
	8.15	5.51	4.55	7.71	9.54	
POOR	12	19	13	18	12	74
	0.20	0.32	0.22	0.30	0.20	1.23
	16.22	25.68	17.57	24.32	16.22	
	1.16	1.78	0.88	1.30	1.15	
TOTAL	1031	1070	1474	1387	1048	6010
	17.15	17.80	24.53	23.08	17.44	100.00

FREQUENCY MISSING = 177

A6-25

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=COURTAULD

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	827	767	1202	1253	792	4841
	14.26	13.22	20.72	21.60	13.66	83.47
	17.08	15.84	24.83	25.88	16.36	
	84.30	78.59	83.41	88.05	80.90	
GOOD	72	104	147	104	106	533
	1.24	1.79	2.53	1.79	1.83	9.19
	13.51	19.51	27.58	19.51	19.89	
	7.34	10.66	10.20	7.31	10.83	
MODERATE	75	80	74	55	69	353
	1.29	1.38	1.28	0.95	1.19	6.09
	21.25	22.66	20.96	15.58	19.55	
	7.65	8.20	5.14	3.87	7.05	
POOR	7	25	18	11	12	73
	0.12	0.43	0.31	0.19	0.21	1.26
	9.59	34.25	24.66	15.07	16.44	
	0.71	2.56	1.25	0.77	1.23	
TOTAL	981	976	1441	1423	979	5800
	16.91	16.83	24.84	24.53	16.88	100.00

FREQUENCY MISSING = 387

A6-2.6

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)					YEAR		
FREQUENCY	PERCENT						
ROW PCT	COL PCT						
COL PCT		1980	1981	1982	1983	1984	TOTAL
VERY GOOD		1612	2132	2192	1669	2073	9678
		13.41	17.73	18.23	13.88	17.24	80.48
		16.66	22.03	22.65	17.25	21.42	
		66.45	84.24	85.33	76.38	89.59	
GOOD		461	231	233	352	146	1423
		3.83	1.92	1.94	2.93	1.21	11.83
		32.40	16.23	16.37	24.74	10.26	
		19.00	9.13	9.07	16.11	6.31	
MODERATE		312	148	126	138	92	816
		2.59	1.23	1.05	1.15	0.77	6.79
		38.24	18.14	15.44	16.91	11.27	
		12.86	5.85	4.90	6.32	3.98	
POOR		41	20	18	26	3	108
		0.34	0.17	0.15	0.22	0.02	0.90
		37.96	18.52	16.67	24.07	2.78	
		1.69	0.79	0.70	1.19	0.13	
TOTAL		2426	2531	2569	2185	2314	12025
		20.17	21.05	21.36	18.17	19.24	100.00

FREQUENCY MISSING = 436

A6-27

ONTARIO MINISTRY OF THE ENVIRONMENT
SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=DOMTAR

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1234	1710	1618	1935	1168	7665
	11.13	15.42	14.59	17.45	10.53	69.13
	16.10	22.31	21.11	25.24	15.24	
	57.91	75.93	64.10	82.20	63.93	
GOOD	435	309	579	286	239	1848
	3.92	2.79	5.22	2.58	2.16	16.67
	23.54	16.72	31.33	15.48	12.93	
	20.41	13.72	22.94	12.15	13.08	
MODERATE	403	192	294	114	365	1368
	3.63	1.73	2.65	1.03	3.29	12.34
	29.46	14.04	21.49	8.33	26.68	
	18.91	8.53	11.65	4.84	19.98	
POOR	59	41	33	19	55	207
	0.53	0.37	0.30	0.17	0.50	1.87
	28.50	19.81	15.94	9.18	26.57	
	2.77	1.82	1.31	0.81	3.01	
TOTAL	2131	2252	2524	2354	1827	11088
	19.22	20.31	22.76	21.23	16.48	100.00

FREQUENCY MISSING = 1373

A6-28

CANADIAN HISTORY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)		YEAR				
FREQUENCY	PERCENT					
ROW PCT	COL PCT	1980	1981	1982	1983	1984
TOTAL						
VERY GOOD		2508	2840	2296	1955	2809
		18.98	21.50	17.38	14.80	21.26
		20.21	22.89	18.50	15.76	22.64
		94.46	96.50	94.45	88.50	94.48
GOOD		83	56	67	157	65
		0.63	0.42	0.51	1.19	0.49
		19.39	13.08	15.65	36.68	15.19
		3.13	1.90	2.76	7.11	2.19
MODERATE		54	46	47	79	93
		0.41	0.35	0.36	0.60	0.70
		16.93	14.42	14.73	24.76	29.15
		2.03	1.56	1.93	3.58	3.13
POOR		10	1	21	18	6
		0.08	0.01	0.16	0.14	0.05
		17.86	1.79	37.50	32.14	10.71
		0.38	0.03	0.86	0.81	0.20
TOTAL		2655	2943	2431	2209	2973
		20.10	22.28	18.40	16.72	22.50
		13211				
		100.00				

FREQUENCY MISSING = 448

A6-29

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=OTHER

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)	YEAR					
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	2153	2464	1870	2205	2361	11053
	17.19	19.67	14.93	17.60	18.85	88.25
	19.48	22.29	16.92	19.95	21.36	
	90.31	91.29	78.64	94.64	86.36	
GOOD	156	167	277	72	230	902
	1.25	1.33	2.21	0.57	1.84	7.20
	17.29	18.51	30.71	7.98	25.50	
	6.54	6.19	11.65	3.09	8.41	
MODERATE	68	62	181	46	132	489
	0.54	0.50	1.45	0.37	1.05	3.90
	13.91	12.68	37.01	9.41	26.99	
	2.85	2.30	7.61	1.97	4.83	
POOR	7	6	50	7	11	81
	0.06	0.05	0.40	0.06	0.09	0.65
	8.64	7.41	61.73	8.64	13.58	
	0.29	0.22	2.10	0.30	0.40	
TOTAL	2384	2699	2378	2330	2734	12525
	19.03	21.55	18.99	18.60	21.83	100.00

FREQUENCY MISSING = 1134

A6-30

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF H2S BY YEAR

H2S(HYDROGEN SULPHIDE PARTS PER BILLION)		YEAR				
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	2235	1927	1849	1293	2117	9421
	21.36	18.42	17.67	12.36	20.24	90.05
	23.72	20.45	19.63	13.72	22.47	
	89.04	93.18	90.59	82.41	93.10	
GOOD	151	85	126	153	77	592
	1.44	0.81	1.20	1.46	0.74	5.66
	25.51	14.36	21.28	25.84	13.01	
	6.02	4.11	6.17	9.75	3.39	
MODERATE	104	44	57	104	72	381
	0.99	0.42	0.54	0.99	0.69	3.64
	27.30	11.55	14.96	27.30	18.90	
	4.14	2.13	2.79	6.63	3.17	
POOR	20	12	9	19	8	68
	0.19	0.11	0.09	0.18	0.08	0.65
	29.41	17.65	13.24	27.94	11.76	
	0.80	0.58	0.44	1.21	0.35	
TOTAL	2510	2068	2041	1569	2274	10462
	23.99	19.77	19.51	15.00	21.74	100.00

FREQUENCY MISSING = 335

A6-31

ONTARIO MINISTRY OF THE ENVIRONMENT
 SOURCE RELATED CROSSTABULATION OF REDUCED SULPHUR
 AIR QUALITY SUBINDEX TABLES FOR REDUCED SULPHURS 1980-1984
 WIND SPEED LESS THAN 5 KM/HR ASSIGNS SOURCE= UNKNOWN

ORIGIN=UNKNOWN

TABLE OF TRS BY YEAR

TRS(H2S AT ST.FRANCIS SCHOOL)		YEAR				
FREQUENCY						
PERCENT						
ROW PCT						
COL PCT	1980	1981	1982	1983	1984	TOTAL
VERY GOOD	1767	1572	1470	1345	1628	7782
	17.79	15.82	14.80	13.54	16.39	78.34
	22.71	20.20	18.89	17.28	20.92	
	77.26	81.41	73.13	77.61	82.51	
GOOD	227	183	285	201	162	1058
	2.29	1.84	2.87	2.02	1.63	10.65
	21.46	17.30	26.94	19.00	15.31	
	9.93	9.48	14.18	11.60	8.21	
MODERATE	225	142	187	142	172	868
	2.26	1.43	1.88	1.43	1.73	8.74
	25.92	16.36	21.54	16.36	19.82	
	9.84	7.35	9.30	8.19	8.72	
POOR	68	34	68	45	11	226
	0.68	0.34	0.68	0.45	0.11	2.28
	30.09	15.04	30.09	19.91	4.87	
	2.97	1.76	3.38	2.60	0.56	
TOTAL	2287	1931	2010	1733	1973	9934
	23.02	19.44	20.23	17.45	19.86	100.00

FREQUENCY MISSING = 863

A6-32

DEC 23, 1986

ANALYSIS OF HI-VOL DATA FOR 1980

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1													1
2						58	62						2
3		38		62	68								3
4	99		74										4
5											26	32	5
6									57	34			6
7								87					7
8		70		24	63	43	59						8
9													9
10	46		45										10
11											41	****	11
12									42	25			12
13								46					13
14						104	64						14
15		52		98	60								15
16	87		37										16
17											55	15	17
18													18
19									37	47			19
20						57	67	52					20
21		70		54	105								21
22	51		45										22
23											61	51	23
24									38	30			24
25								59					25
26						114	55						26
27		43		58	80								27
28	36		104										28
29											20	61	29
30									75	32			30
31								52					31
ARITH MEAN	64	55	61	59	75	75	61	59	50	34	41	40	ARITH MEAN
MAXIMUM	99	70	104	98	105	114	67	87	75	47	61	61	MAXIMUM
GEOM MEAN	59	53	57	54	74	70	61	58	48	33	37	35	GEOM MEAN
EST AVERAGE	65	55	62	61	76	77	61	59	50	34	42	43	EST AVERAGE
SAMPLE SIZE	5	5	5	5	5	5	5	5	5	5	5	4	SAMPLE SIZE
NO. OF SAMPLES	59	15	10	30	50	60	70	80	90	95	98	99	MAX
YEAR	59	15	32	44	55	59	62	70	89	104	105	109	114
										56		52	1.53
													57

A7-1

ANALYSIS OF HI-VOL DATA FOR 1981

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1									34	36			1
2								81					2
3		36			83	68	47						3
4	28			18									4
5			92										5
6											40	28	6
7									90	24			7
8								23					8
9		22				55	76						9
10	29			60	59								10
11			30										11
12												23	12
13										116			13
14													14
15		80				67	42	55					15
16	86			87	20								16
17													17
18												45	18
19									50	22			19
20								75					20
21		49				47	36						21
22	51				51								22
23			62										23
24											57	45	24
25									80	40			25
26								52					26
27		59				44	25						27
28	61			45	54								28
29			73										29
30											45	35	30
31										84			31
ARITH MEAN	51	49	64	53	53	56	45	57	64	54	47	35	ARITH MEAN
MAXIMUM	86	80	92	87	83	68	76	81	90	116	57	45	MAXIMUM
GEOM MEAN	46	45	59	45	49	55	42	53	59	44	47	34	GEOM MEAN
EST AVERAGE	52	51	67	57	56	56	46	60	65	55	48	36	EST AVERAGE
SAMPLE SIZE	5	5	4	4	5	5	5	5	4	6	3	5	SAMPLE SIZE
NO. OF SAMPLES	56	18	10	30	50	60	70	80	90	95	98	99	MAX
YEAR	56	18	23	38	49	55	60	75	83	88	92	102	116
													52
													47
													1.58
													52

A7-2

ANALYSIS OF HI-VOL DATA FOR 1982

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1											28	62	1				
2									31	47			2				
3								30					3				
4		33				30	24						4				
5	42			49	55								5				
6			44										6				
7											38	31	7				
8									43	36			8				
9								38					9				
10		32				45	42						10				
11	35			24	37								11				
12			62										12				
13											18	27	13				
14									21	25			14				
15								42					15				
16		32				43	68						16				
17				58	46								17				
18			71										18				
19											72	47	19				
20													20				
21								20					21				
22		47				29	49						22				
23	42			60	41								23				
24			86										24				
25											38	32	25				
26									38	112			26				
27								39					27				
28		42				40	21		47				28				
29				53									29				
30			78										30				
31												35	31				
ARITH MEAN	40	37	68	49	45	37	41	34	36	55	39	39	ARITH MEAN				
MAXIMUM	42	47	86	60	55	45	68	42	47	112	72	62	MAXIMUM				
GEOM MEAN	40	37	66	46	44	37	37	33	35	47	35	37	GEOM MEAN				
EST AVERAGE	40	37	69	50	45	38	42	34	36	57	40	39	EST AVERAGE				
SAMPLE SIZE	3	5	5	5	4	5	5	5	5	4	5	6	SAMPLE SIZE				
	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM STD DEV	ESTIMATED AVERAGE
YEAR	57	18	25	33	41	43	47	52	64	73	85	97	112	43	40	1.46	43

A7-3

ANALYSIS OF HI-VOL DATA FOR 1983

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1			108										1
2											108		2
3									63	81			3
4													4
5		23				57	68						5
6	37				57								6
7			47										7
8											50		8
9									68	18			9
10													10
11		78				71	50						11
12	25			41	74								12
13			31										13
14											44	12	14
15									67	29			15
16													16
17		52				95							17
18	22			42	72								18
19			28										19
20												22	20
21									58	55			21
22								32					22
23		46				140	51						23
24				25	44								24
25			47										25
26													26
27									57	31			27
28								40					28
29						63	85						29
30	61			74	35								30
31													31
ARITH MEAN	36	50	52	46	56	85	64	36	63	43	67	17	ARITH MEAN
MAXIMUM	61	78	108	74	74	140	85	40	68	81	108	22	MAXIMUM
GEOM MEAN	33	46	46	42	54	81	62	36	62	37	62	16	GEOM MEAN
EST AVERAGE	37	52	53	47	57	86	64	36	63	44	70	18	EST AVERAGE
SAMPLE SIZE	4	4	5	4	5	5	4	2	5	5	3	2	SAMPLE SIZE

	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM DEV	STD DEV	ESTIMATED AVERAGE
YEAR	48	12	24	40	50	57	63	72	82	103	110	124	140	54	48	1.66		55

A7-4

DEC 23, 1986

ANALYSIS OF HI-VOL DATA FOR 1984

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY					
1			188										1					
2											30		2					
3									24				3					
4								52					4					
5						86	48						5					
6		32		48	54								6					
7	37												7					
8											48	33	8					
9									40	37			9					
10								54					10					
11						80	41						11					
12		40		80	75								12					
13	46												13					
14											54	30	14					
15									16	69			15					
16								30					16					
17						57	31						17					
18		83		49									18					
19	52												19					
20											43	58	20					
21									29	25			21					
22								47					22					
23						55	79						23					
24				19	48								24					
25	41		71										25					
26													26					
27									29	41			27					
28								66					28					
29						56	23						29					
30				160	27								30					
31	44		65										31					
ARITH MEAN	44	52	108	71	51	67	44	50	28	43	44	40	ARITH MEAN					
MAXIMUM	52	83	188	160	75	86	79	66	40	69	54	58	MAXIMUM					
GEOM MEAN	44	47	95	56	48	66	41	48	26	40	43	39	GEOM MEAN					
EST AVERAGE	44	54	113	77	52	67	45	50	28	44	44	41	EST AVERAGE					
SAMPLE SIZE	5	3	3	5	4	5	5	5	5	4	4	3	SAMPLE SIZE					
	NO. OF	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH	GEOM	GEOM	STD	ESTIMATED
	SAMPLES													MEAN	MEAN	DEV		AVERAGE
YEAR	51	16	27	37	48	52	55	66	80	84	160	173	188	52	46	1.61		52

A7-5

DEC 23, 1986

STATION - SE NO 56006 4 MONTREAL RD CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1									43	38			1				
2								69					2				
3		38				68							3				
4	34			58	89								4				
5													5				
6											62	27	6				
7										22			7				
8		25				44	66	29					8				
9													9				
10	30			63	62								10				
11			48										11				
12												19	12				
13										115			13				
14		82				65	35	50					14				
15													15				
16					22								16				
17			66										17				
18											21	60	18				
19									50	29			19				
20								83					20				
21		59				54	32						21				
22	53				54								22				
23			69										23				
24											70	34	24				
25									66	52			25				
26													26				
27		76				50	27	61					27				
28	85			67	56								28				
29			71										29				
30												42	30				
31										108			31				
ARITH MEAN	51	56	64	63	57	56	40	58	53	61	51	36	ARITH MEAN				
MAXIMUM	85	82	71	67	89	68	66	83	66	115	70	60	MAXIMUM				
GEOM MEAN	46	51	63	63	52	55	38	55	52	50	45	34	GEOM MEAN				
EST AVERAGE	52	58	64	63	59	56	41	60	53	63	56	37	EST AVERAGE				
SAMPLE SIZE	4	5	4	3	5	5	4	5	3	6	3	5	SAMPLE SIZE				
	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM STD DEV	ESTIMATED AVERAGE
YEAR	52	19	27	39	54	61	66	69	81	87	108	111	115	54	49	1.55	54

STATION - SE NO 56006 4 MONTREAL RD CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1										33		67	1				
2													2				
3								42					3				
4	33			36	68	29							4				
5													5				
6			36										6				
7											32	27	7				
8									51	39			8				
9								30					9				
10		28				54	48						10				
11	32			38	45								11				
12			61										12				
13												26	13				
14									75	28			14				
15								30					15				
16						37	63						16				
17	21			38	55								17				
18			109										18				
19											54		19				
20									39				20				
21								22					21				
22		68				43	54						22				
23	32			40	48								23				
24			77										24				
25											38	37	25				
26									57	98			26				
27								42					27				
28		49				47	25						28				
29	9			72	63								29				
30			66										30				
31												40	31				
ARITH MEAN	25	48	70	45	56	42	48	33	56	50	41	39	ARITH MEAN				
MAXIMUM	33	68	109	72	68	54	63	42	75	98	54	67	MAXIMUM				
GEOM MEAN	23	45	66	43	55	41	45	32	54	43	40	37	GEOM MEAN				
EST AVERAGE	27	50	71	45	56	42	49	33	56	51	42	40	EST AVERAGE				
SAMPLE SIZE	5	3	5	5	5	5	4	5	4	4	3	5	SAMPLE SIZE				
	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM STD DEV	ESTIMATED AVERAGE
YEAR	53	9	27	35	40	47	54	62	68	76	97	103	109	46	42	1.54	46

A7-1

DEC 23, 1986

ANALYSIS OF HI-VOL DATA FOR 1983

STATION - SE NO 56006 4 MONTREAL RD CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1			75										1				
2											49	10	2				
3									50	21			3				
4								65					4				
5		23				39	51						5				
6	34				40								6				
7			36										7				
8												18	8				
9										29			9				
10								27					10				
11		137				55							11				
12	165			24	53								12				
13			37										13				
14												17	14				
15									64	21			15				
16								54					16				
17		35				64	26						17				
18	21			29	56								18				
19			9										19				
20												27	20				
21									34	57			21				
22								27					22				
23		27				73	36						23				
24	29			17	63								24				
25			35										25				
26													26				
27											26		27				
28									54	27			28				
29						60	50	31					29				
30	65			43	28								30				
31													31				
ARITH MEAN	63	56	38	28	48	58	41	41	51	31	38	18	ARITH MEAN				
MAXIMUM	165	137	75	43	63	73	51	65	64	57	49	27	MAXIMUM				
GEOM MEAN	47	42	32	27	46	57	39	38	49	29	36	17	GEOM MEAN				
EST AVERAGE	65	58	43	29	49	59	41	41	51	31	39	18	EST AVERAGE				
SAMPLE SIZE	5	4	5	4	5	5	4	5	4	5	2	4	SAMPLE SIZE				
	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM STD DEV	ESTIMATED AVERAGE
YEAR	52	9	21	27	35	42	52	57	65	74	135	150	165	43	37	1.75	43

A7-8

ANALYSIS OF HI-VOL DATA FOR 1984

STATION - SE NO 56006 4 MONTREAL RD CORNWALL

POLLUTANT - SUSPENDED PARTICULATE

UNIT - MICROGMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1			33										1
2											27		2
3									25	32			3
4								53					4
5						72							5
6		27		122	56								6
7	45												7
8											49	33	8
9									47	45			9
10								56					10
11						64	53						11
12		41			48								12
13	41												13
14											42	31	14
15									20	84			15
16								35					16
17						47	38						17
18		76		38	67								18
19	49												19
20											34	26	20
21									35	26			21
22								47					22
23						58	74						23
24		109		18	39								24
25	36		22										25
26												36	26
27									41	38			27
28													28
29							28						29
30				116	33								30
31	30		63										31
ARITH MEAN	40	63	39	74	49	60	48	48	34	45	38	32	ARITH MEAN
MAXIMUM	49	109	63	122	67	72	74	56	47	84	49	36	MAXIMUM
GEOM MEAN	40	55	36	56	47	60	45	47	32	41	37	31	GEOM MEAN
EST AVERAGE	40	67	41	86	49	61	49	48	34	46	38	32	EST AVERAGE
SAMPLE SIZE	5	4	3	4	5	4	4	4	5	5	4	4	SAMPLE SIZE
	NO. OF												
	SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX
													ARITH MEAN
													GEOM MEAN
													GEOM STD
													DEV
													ESTIMATED
													AVERAGE
YEAR	51	18	26	34	41	47	49	58	74	96	116	119	122
													47
													43
													1.54
													47

A7-9

ANALYSIS OF HI-VOL DATA FOR 1980

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - LEAD - ATOMIC ABSORPTION (HIVOL)

UNIT - 0.1 MICROGRAMS/CU.METRE

A7-10

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1													1				
2						0	3						2				
3		1		3	0								3				
4	6		2										4				
5											0	2	5				
6									1	0			6				
7								1					7				
8						0	0						8				
9		3		3	0								9				
10	2		2										10				
11											0		11				
12									3	0			12				
13								1					13				
14						0	0						14				
15		2		2	2								15				
16	4		2										16				
17											4	0	17				
18									0	0			18				
19								2					19				
20						2	0						20				
21		2		2	5								21				
22	4		3										22				
23											7	4	23				
24									2	0			24				
25								0					25				
26						3	0						26				
27		2		2	0								27				
28	2		4										28				
29											0	6	29				
30									2	0			30				
31								0					31				
ARITH MEAN	4	2	3	2	1	1	1	1	2	0	2	3	ARITH MEAN				
MAXIMUM	6	3	4	3	5	3	3	2	3		7	6	MAXIMUM				
GEOM MEAN	3	2	2	2	1	1	0	1	1	0	1	2	GEOM MEAN				
EST AVERAGE	4	2	3	2	2	1	1	1	2	0	4	6	EST AVERAGE				
SAMPLE SIZE	5	5	5	5	5	5	5	5	5	5	5	4	SAMPLE SIZE				
	NO. OF												ARITH	GEOM	GEOM	STD	ESTIMATED
	SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	MEAN	MEAN	DEV	AVERAGE
YEAR	59	0	1	1	2	2	2	3	4	5	6	6	7	2	1	3.62	2

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - LEAD - ATOMIC ABSORPTION (HIVOL)

UNIT - 0.1 MICROGRAMS/CU.METRE

A7-11

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

UNIT - 0.1 MICROGRAMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1			9										1				
2											8		2				
3									2	2			3				
4													4				
5		2				1	1						5				
6	3				2								6				
7			2										7				
8											2		8				
9									2	1			9				
10													10				
11		5				2	1						11				
12	1			2	5								12				
13			1										13				
14											3	2	14				
15									4	1			15				
16													16				
17		3				2							17				
18	1			1	2								18				
19			2										19				
20												3	20				
21									1	4			21				
22								2					22				
23		2				2	1						23				
24				1	2								24				
25			2										25				
26													26				
27									3	2			27				
28								3					28				
29						3	1						29				
30	4			6	2								30				
31													31				
ARITH MEAN	2	3	3	3	3	2	1	3	2	2	4	3	ARITH MEAN				
MAXIMUM	4	5	9	6	5	3	1	3	4	4	8	3	MAXIMUM				
GEOM MEAN	2	3	2	2	2	2	1	2	2	2	4	2	GEOM MEAN				
EST AVERAGE	2	3	3	3	3	2	1	3	2	2	5	3	EST AVERAGE				
SAMPLE SIZE	4	4	5	4	5	5	4	2	5	5	3	2	SAMPLE SIZE				
	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM DEV	STD ESTIMATED AVERAGE
YEAR	48	1	1	2	2	2	3	3	4	6	8	9	9	2	2	1.79	2

ANALYSIS OF HI-VOL DATA FOR 1984

STATION - SE NO 56051 MEMORIAL PK, BEDFORD/THIRD STS CORNWALL

POLLUTANT - LEAD - ATOMIC ABSORPTION (HIVOL)

UNIT - 0.1 MICROGRAMS/CU.METRE

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1			14										1				
2											1		2				
3									1				3				
4								1					4				
5						1	1						5				
6		1		1	1								6				
7	1												7				
8											3	2	8				
9									1	2			9				
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30				1	1								30				
31	1		2										31				
ARITH MEAN	2	3	6	1	1	1	1	1	1	3	2	2	ARITH MEAN				
MAXIMUM	3	5	14	2	1	1	1	2	3	5	3	3	MAXIMUM				
GEOM MEAN	1	2	4	1	1	1	1	1	1	2	2	2	GEOM MEAN				
EST AVERAGE	2	3	7	1	1	1	1	1	1	3	2	2	EST AVERAGE				
SAMPLE SIZE	5	3	3	5	4	5	5	5	5	4	4	3	SAMPLE SIZE				
	NO. OF SAMPLES	MIN	10	30	50	60	70	80	90	95	98	99	MAX	ARITH MEAN	GEOM MEAN	GEOM STD DEV	ESTIMATED AVERAGE
YEAR	51	1	1	1	1	1	2	2	3	4	5	8	14	2	1	1.80	1

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CORNWALL AIR QUALITY REPORT
TABLE 1 STATISTICAL TERMS AND DEFINITIONS.

Below are a list of terms used in the description of the data presented in this report . While most of them are universally defined , some are not . This will be indicated and referenced.

MEAN- The mean is most commonly understood as the average , but it has two common meanings . The most common is the ARITHMETIC MEAN . It is defined as the sum of all observations divided by the total number of observations . It is the most common estimator of central tendency in descriptive statistics. It is also referred to as the FIRST MOMENT in some texts.

STANDARD DEVIATION-The standard deviation is a parameter describing the amount of scatter that actual observations drawn from a NORMAL POPULATION will take about the MEAN. It is often referred to simply as the DEVIATION . However it has several different usages . The true STANDARD DEVIATION is a theoretical entity, which we attempt to measure via observation . The deviation of the measurements is called the SAMPLE STANDARD DEVIATION . It is related to the POPULATION STANDARD DEVIATION by the following formula:

$$S = \left[\sum (x_i - \bar{x})^2 / n - 1 \right]^{1/2}$$

This equation applies to small samples randomly drawn from a parent normal population.

VARIANCE - The variance is a term describing scatter about the mean of a body of related data . It is the sum of the squares of the differences of each observation in a data set and the mean of that data set . It is mathematically expressed as:

$$\sigma^2 = E[(x - \mu)^2]$$

It is always positive (greater or equal to zero) . the VARIANCE is also referred to as the SECOND MOMENT.

COEFFICIENT OF VARIATION : The ratio of the standard deviation to the mean , expressed as a percentage . It can be used as a rough estimator of goodness of fit of the data to a given normal distribution .

DISTRIBUTION : A mathematical statement describing the probability of observation of a given value for a variable under certain circumstances . Examples are the NORMAL, LOGNORMAL , BINOMIAL , POISSON , DIGAMMA , EXPONENTIAL . They are different equations which have found wide success in many areas of science , particularly in physics . Each has it's own theoretical basis and area of application . The reader is referred to the bibliography for a short and incomplete list of references on this large body of theory.

SKEWNESS : Skewness is a measure of asymmetry in a group of measurements . A symmetric group will have equal amounts of data falling at equal distances from the average , and so will exhibit no skewness . It is defined mathematically by:

$$\left[n / (n-1)(n-2) \right] \sum_n (x - \bar{x})^3 / s^3$$

A Normal distribution shows a skewness of zero . Skewness can be positive or negative , depending on the nature of the asymmetry shown . Skewness is also referred to as the THIRD MOMENT.

KURTOSIS: Kurtosis is a term describing the nature of a distribution to display extreme values . This term has two general methods of computation. The first, and the one used in this report is :

$$\left[n(n+1) / (n-1)(n-2)(n-3) \right] \sum_n \left[(x_i - \bar{x})^4 / (s^4 - 3(n-1)(n-1) / (n-2)(n-3)) \right]$$

An alternate form is :

$$E[(x - \mu)^4] / s^4 - 3$$

The kurtosis of a Normal population is exactly 3 . The second term is actually defined as the COEFFICIENT OF EXCESS , and is used to compare data expected to be similar to a Normal . This is NOT the usage in this report .

PERCENTILE : A nonparametric descriptor of a dataset with the following meaning . The 10th percentile is the value in an ordered set of data such that 10 percent of the observations are equal or less than it . It is simply

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defined when observations are never repeated , but can become unclear when values are repeated many times . Some methods of calculation use complex interpolation techniques . However , for integer data , they can result in a percentile value that will never occur in the data from which it is computed . No interpolation methods were used in this report for the calculation of percentiles . Observation of many equal percentiles shows a large amount of equal observation in a data set .

FIRST QUARTILE: The 25 th PERCENTILE. One quarter of the data is equal or less than the FIRST QUARTILE.

SECOND QUARTILE: The 50 th percentile. The Second Quartile is also the MEDIAN.

THIRD QUARTILE : The 75th percentile.

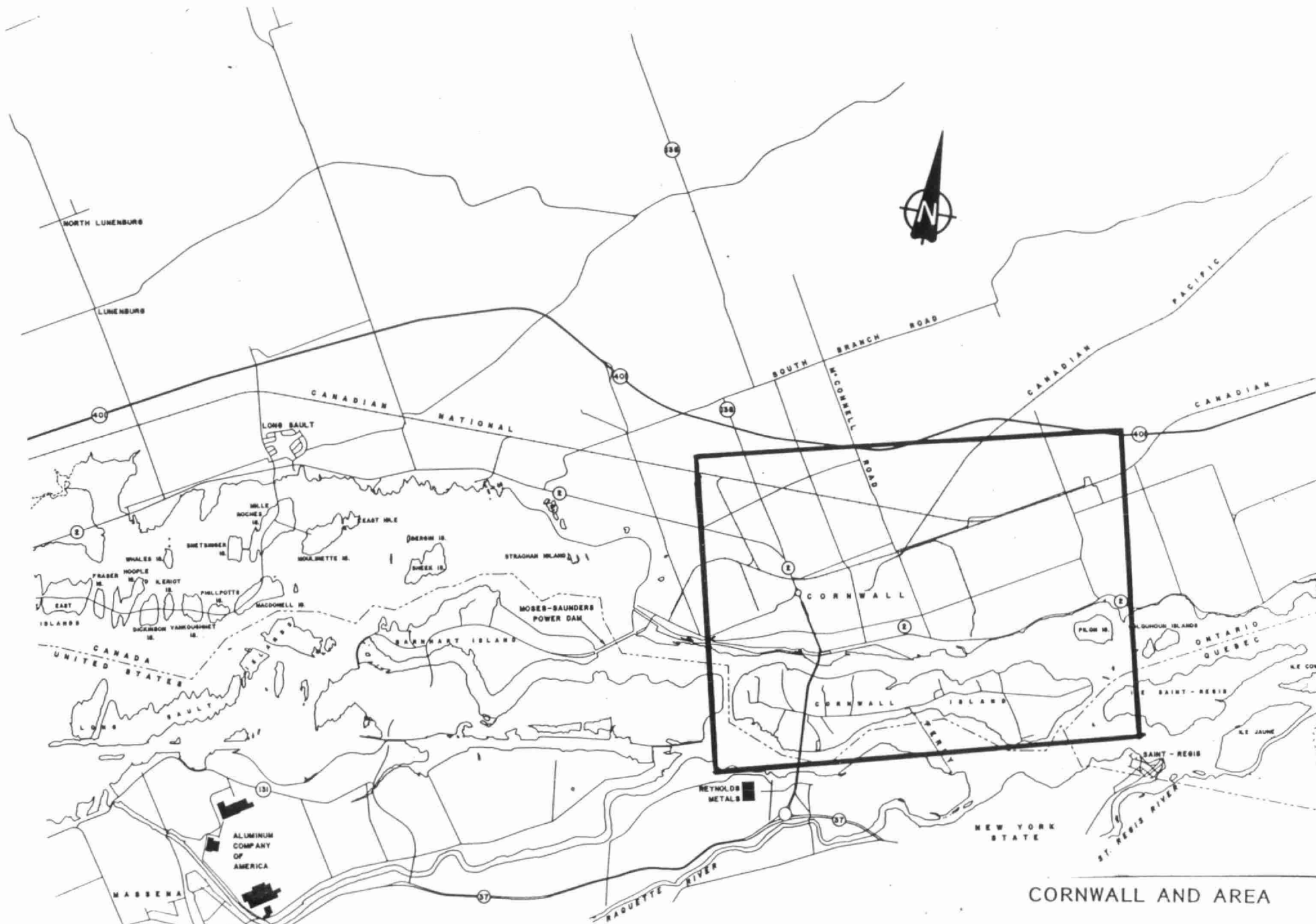
MEDIAN: THE 50 th percentile . For a Normal distribution, the median and the mean are equal .

MODE : The most frequently observed value in a dataset . Mathematically it represents the maximum of the probability distribution . For a Normal distribution, the mean equals the mode.

LOGNORMAL : A sample distribution in which the logarithms of data values are NORMALLY DISTRIBUTED.

SPLINE INTERPOLATION : A method of connecting data points in a graphic presentation . Splines have the property of smoothness of fit , and will pass through all data points used in the plot. Smoothness is defined by a continuous second derivative of the generated curve .

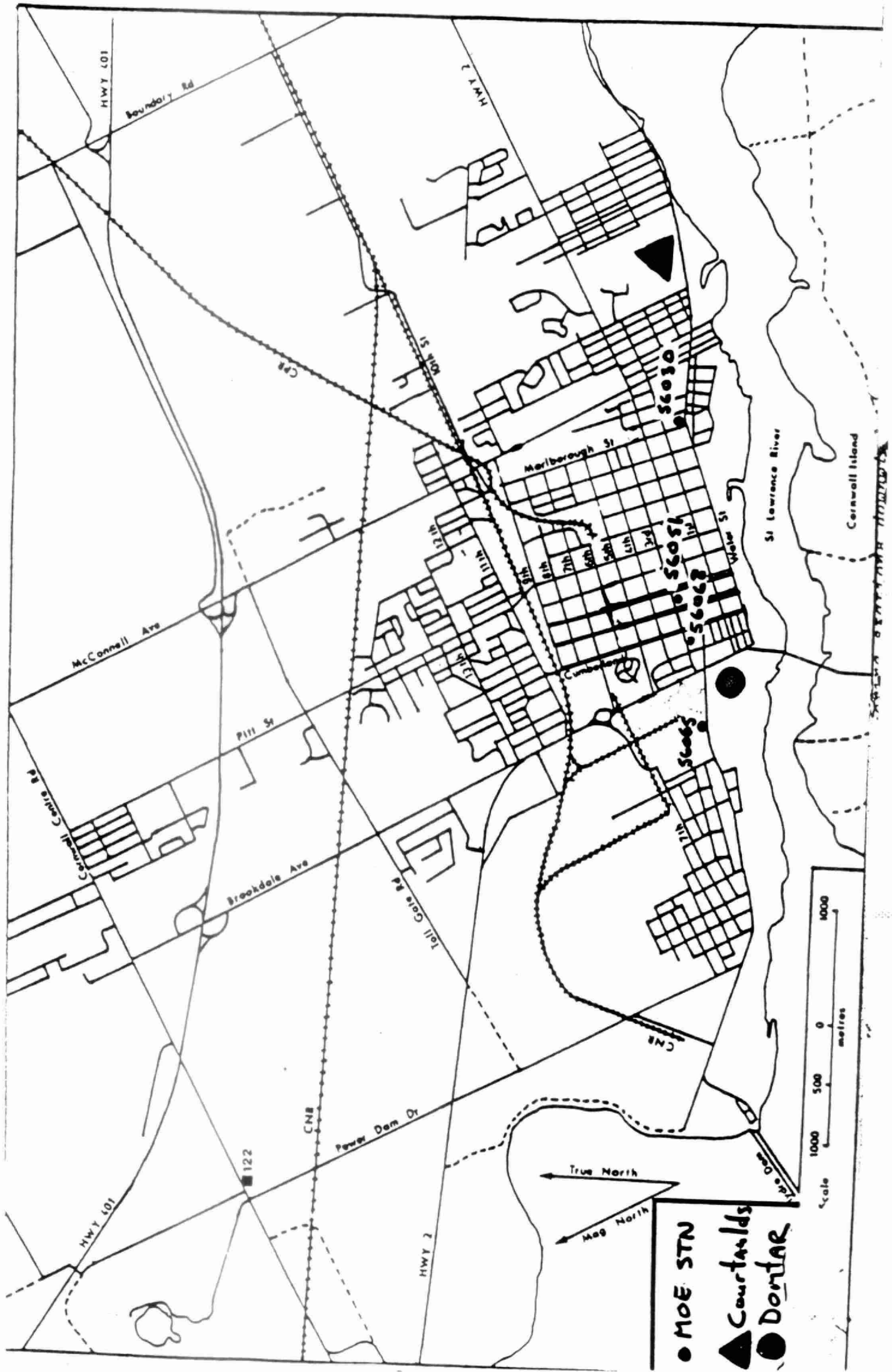
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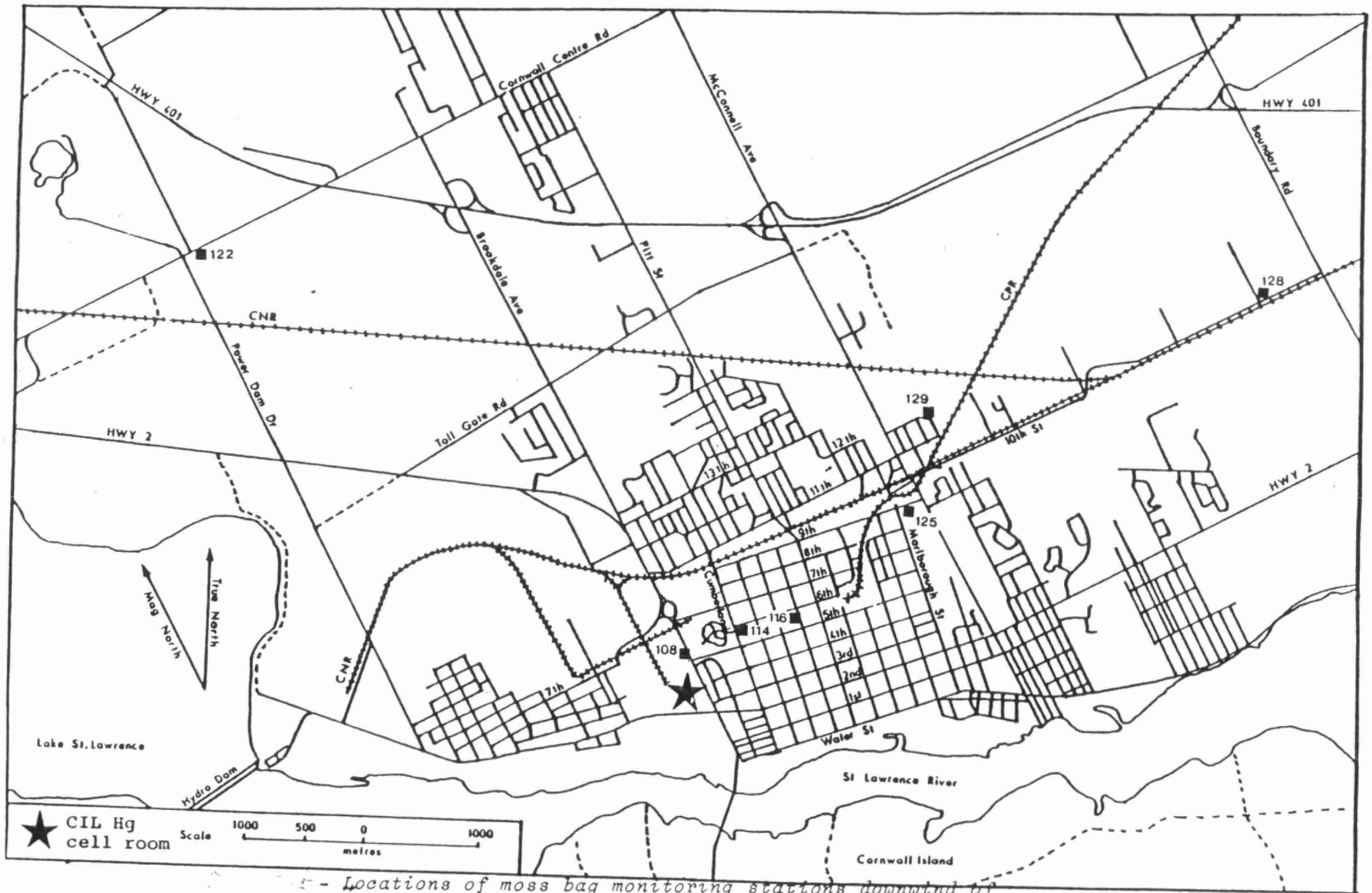


CORNWALL AND AREA

ENCLOSED AREA IS
ENLARGED ON NEXT
PAGE

1 0 1 2 3 4 km
APPROXIMATE SCALE





1 - Locations of moss bag monitoring stations downwind of CIL, Cornwall - 1982.

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